DOCUMENT RESUME

ED 021 792 24 SP 001 525

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PLANNING EDUCATIONAL EXPERIMENTS: SUMMER INSTITUTE FINAL REPORT (JUNE 13-AUGUST 6, 1966).

Arizona State Univ., Tempe. Classroom Learning Lab.

Spons Agency- Office of Education (DHEW), Washington, D.C. Bureau of Research.

Report No- FR-3-66

Bureau No- BR-6-1676

Pub Date 1 May 67

Grant- OEG-4-6-061676-1016

Note- 93p.

EDRS Price MF-$0.50 HC-$3.80

Descriptors- *ADMINISTRATIVE PERSONNEL, CURRICULUM RESEARCH, EDUCATIONAL EXPERIMENTS, *EDUCATIONAL RESEARCH, *INSTITUTES (TRAINING PROGRAMS), LEARNING LABORATORIES, PROGRAM CONTENT, PROGRAM EVALUATION, QUESTIONNAIRES, *RESEARCH METHODOLOGY, STATISTICAL ANALYSIS

Identifiers- Arizona State University

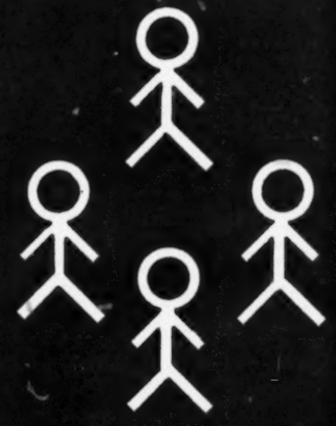
The purpose of an 8-week summer training institute was to provide 25 competent professional school personnel the necessary methodological skills to initiate, conduct, and report experiments on school learning and instruction. All trainees held administrative posts with responsibilities for curriculum research and development and/or instruction. A supervised laboratory program was built around these courses: Experimental Analysis of Instruction and Learning, Principles and Procedures for Experimentation Under School Conditions, and Experimental Design and Statistical Analysis. Laboratory activities included designing experiments, writing proposals, writing instructional specifications, and performing exercises in statistical techniques. Group consultations, guest lectures, and individual study supplemented the lecture-laboratory format. The institute was considered generally successful in that trainees exhibited ability to perform respectable experimentation under natural school conditions. Each had at least one proposal ready to work on, and posttest results indicated that varying levels of achievement were parallel to the heterogeneity in professional preparation and background. Appended are the institute schedule; participant evaluation scales and summaries of questionnaire results; samples of course materials and final course quizzes; and information about the participants. (JS)

BR 6-1676
PA 24

Summer Institute Final Report
"Planning Educational Experiments"
June 13 - August 6, 1966

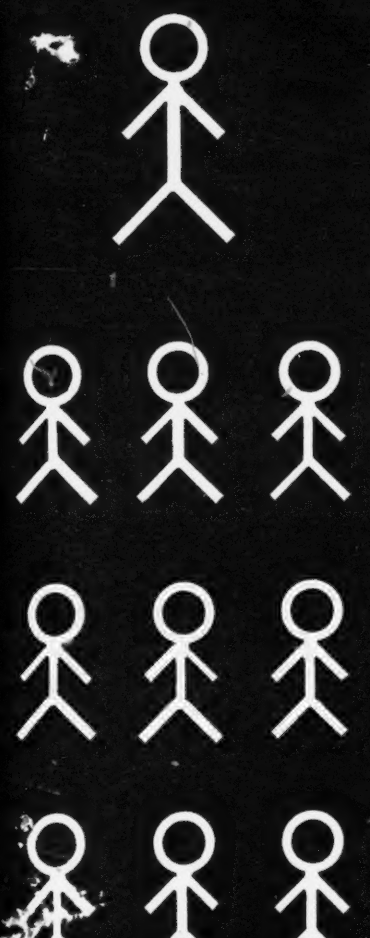
Robert L. Baker, Director

Training of Researchers, Title IV, PL 89-10
Grant Number: OEG 4-6-061676-1016



CLASSROOM LEARNING LABORATORY

experimental analyses of student behavior



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May 1, 1967

FR-3-66

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Bureau of Research

SP001525

Summer Institute

"Planning Educational Experiments"

Grant Number: OEG 4-6-061676-1016

Robert L. Baker, Director

June 13 - August 6, 1967

The training program reported herein was conducted pursuant to a grant from the Office of Education, United States Department of Health, Education, and Welfare. Grantees undertaking such projects under Government sponsorship are encouraged to express freely their professional judgement of the conduct of the project. Points of view of opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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Summer Institute*

Training of Researchers

"Planning Educational Experiments"

June 13 - August 6, 1966

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*This institute was supported by Arizona State Univeristy and by the U.S. Office of Education under the provisions of Title IV of the Elementary-Secondary Act (PL 89-10) as amended.

I. Introduction

A. General Purpose

The purpose of this institute was to provide competent professional school personnel the necessary methodological skills to initiate, conduct, and report experiments on school learning and instruction.

Although everyone is willing to acknowledge the desirability of controlled experimentation on school learning and instruction, few controlled experiments are actually conducted in the public schools. Recent legislation has removed many of the barriers to school experimentation, but other limitations remain. One patent obstacle is that heretofore the key school personnel who are the logical persons to initiate, design, and conduct such experiments have been otherwise involved. They had neither the time nor the technical research competence to provide the necessary leadership.

Such competence is not easy to obtain in the traditional university context. Methodological research training typically follows a long and laborious route in which an attempt is made to render the student a specialist in many fields including such areas as mathematical statistics, philosophy of science, computer design, psychometric theory, etc. While these areas indeed have relevance to experimentation on instruction, it is unrealistic to expect many people to be both willing and able to complete

This kind of program and at the same time acquire the wherewithal to obtain and hold a key school position. Short of this, the only training typically available consists of research methods courses which include discussion of experimentation as one part of the course but do not pretend to develop experimenters.

One might suggest that an easy solution would be to hire competent methodologists to work in a cooperative fashion with the school people. This has not proved a workable arrangement to date. We have observed in several situations where this has been tried that the activities of the two types of personnel closely approximate the parallel play activities of pre-schoolers; the two groups do manage to work in the same general area but on separate aspects of the problem which are seldom integrated into common action. This is not to say that cooperative activities would not be possible. However, effective cooperation is contingent upon school people learning more about methodology and the methodologists learning more about the substantive situation.

This institute was designed to prepare school personnel to perform respectable experimentation under natural school conditions. This did not mean however, that the program was to cram fifteen courses into a single summer. It was not intended that participants completing the institute would be statisticians, psychologists, engineers, or even curriculum specialists. But if they achieved the objectives of the institute, they were able to design, propose, conduct, analyze, and report experiments that would pass the inspection of specialists in each of these areas. Although they were still novices at the end of the institute period in performing experiments, but were in position to perform and had at least one proposal ready to begin work on. Our great hope was that their experiences in the institute would predispose continued research performance and insure increased competency with further experience. Perhaps!

The institute was designed to steer carefully between the Scylla and Charbydis of courses in educational research. We tried to avoid assaulting them with so much jargon and mathematics that the only effect was to make the least mention of the term "experiment" aversive. At the same time we tried to generate more than the short-term enthusiasm that is usually the sole product of the cozy "action" seminar.

The institute gave direct experience in using powerful concepts and procedures basic to school experimentation. When the institute concluded they should have possessed the selected attributes of both the chemist and the cook. Whenever possible they should use the cook's reference books to mediate their behavior; but when the cookbooks fall short, they should have no difficulty recognizing it and should know how to obtain efficiently the specialized chemical help necessary to keep "the proof of the pudding" above question at all times.

B. Number of Participants and Selection Criteria

Twenty-five participants were selected from over one hundred applications. As the objectives of the Institute were designed for persons directly responsible for curriculum decisions, only those individuals who met the following selection criteria were invited to apply:

1. Holds an administrative post in a public or private elementary or secondary school district which has as its major responsibility the direction of curriculum research and development and/or instruction.
2. In lieu of number one above, is directly involved adminis-

tratively or instructionally in curriculum design in a professional teacher-training institution.

3. Possesses general mental ability competitive with the best of the applicants as measured by the Miller Analogies Test.

4. Indicates general academic performance competitive with the best of the applicants as determined by analyses of transcripts of grades earned in college level courses.

5. Shows evidence of a maximum number of years of future continued service to professional education judged relative to the norm of the applicants.

Section IV contains descriptive information about the selected participants.

II. Institute Program

The institute scheduled activities from 8:30 - 11:30 in the morning and 1:00-4:00 in the afternoon Monday through Friday. In general the morning sessions were devoted to full-group lecture-discussions divided into three courses developed specifically for the institute and described below. The afternoon sessions were devoted to small group consultation with individual staff members, guest lectures, assigned laboratory exercises to demonstrate mastery of the objectives considered in the morning sessions, and individual study. Participants enrolled in the graduate college for six semester hours of graduate credit. It was block credit, rather than credit for individual courses in the institute.

A. Objectives

Participants satisfactorily completing the total institute program were prepared to:

1. Distinguish between educational experiments and other forms of professional endeavor.

2. Define the expected outcomes of learning and instruction in terms of observable behavior that is amenable to empirical investigation.

3. Identify the desirable characteristics of independent variables and dependent variables and rank potential variables in accordance with these characteristics.

4. Select the most valid and practical experimental design for investigating a given functional relationship.

5. Write a research proposal which adequately describes the experimental plans.

6. Perform the experimental operations consistent with the design selected.

7. Select the most appropriate statistical procedures for analyzing the experimental data.

8. Perform the necessary statistical analyses using the most appropriate computing vehicle (by hand, desk calculator, punch card processing, electronic data processing) depending upon the extent of the data or the complexity of the analyses.

9. Write up the results of his experiment in a standard form suitable for dissemination to various audiences.

10. Use the results of his experiment as a basis for further experiments.

11. Consult appropriate specialists for advice where needed at all stages of the research.

B. Description of Courses

To conform to conventional organizational patterns the Institute offered three substantive courses and provided for a supervised laboratory program. Following are the course descriptions and objectives:

1. "Experimental Analysis of Instruction and Learning."

Our experience has demonstrated that the language of empirical investigations is not generally in the educator's repertoire. This course involved principles of developing, revising, and testing instructional material. You will engage in task analysis, writing objectives in operational terms, the development of instructional specifications and criterion measures.

The specific behavioral objectives for this course were:

1. Distinguish between educational experiments and other forms

of professional endeavor.
2. Define the expected outcomes of learning and instruction in terms of observable behavior that is amenable to empirical investigation.
3. Identify the desirable characteristics of independent variable and dependent variables and rank potential variables in accordance with these characteristics.

2. "Principles and Procedures for Experimentation Under School Conditions."

This course was concerned with the "technology" of school experimentation. The course covered the range of the mechanics of experimentation from proposal writing through conducting the experimental treatments, and writing a report of the results. At each stage of instruction you will perform exercises designed to illustrate the principles and procedures presented.

The specific behavioral objectives for this course were:
1. Write a research proposal which adequately describes your experimental plans.
2. Perform the experimental operations consistent with the design selected.
3. Write up the results of your experiment in a standard form suitable for dissemination to various audiences.
4. Use the results of your experiment as a basis for further experiments.

3. "Experimental Design and Statistical Analysis."

This course was concerned with design and analysis. The design considerations were based largely on the framework presented by Campbell and Stanley in the Handbook of Research on Teaching. The statistics were treated from a functional rather than a mathematical perspective. The aim was simply that the participants know what statistical procedure to use in a given situation, how to perform the computation using "rules of thumb," and how to interpret the results of the analysis.

The specific behavioral objectives for this course were:
1. Select the most valid and practical experimental design for investigating a given functional relationship.
2. Select the most appropriate statistical procedures for analyzing the experimental data.
3. Perform the necessary statistical analyses using the most appropriate computing vehicle (by hand, desk calculator, punch card processing, electronic data processing) depending upon the extent of the data or the complexity of the analyses.

C. Group Consultations

It was anticipated that there would be some communality of interests and problems among the participants that could be handled most efficiently via small group sessions, aided by individual staff members. The groups were "open-ended" and highly fluid. The emphasis was on problem solving rather than group dynamics. When all aspects of the situation were explored, a given group was dissolved and the participants went on to something else.

D. Guest Lectures

We brought in a different guest lecturer for two days each week. He made two formal presentations and was available for informal consultation. We treated the guest lecturers as "off-line" -- as a source of additional new ideas beyond those being presented by the regular instructional staff. Section III presents a list of the consultants and their topics.

E. Assigned Exercises

The institute was not concerned with talking about experimentation but rather with devloping competency to do it. The Classroom Learning Laboratory has developed a large number of exercises for each aspect of the objectives to be considered in the institute for giving the participants experience in performing the behavior required. Every effort was made to minimize the "busy work" and mechanical aspects of each exercise and at the same time insure their relevance to the natural school situation. These sequenced exercises were an important component of the institute.

F. Individualized Study

Participants were encouraged to pursue aspects of the institute in which they became individually interested. While it was clearly stated that the institute objectives were to be achieved by each participant, the staff made every effort to stimulate additional efforts. Appendix J provides additional descriptive data on the participants' perception of this activity.

III. SUMMARY

If one can establish a relative criterion for judging institute success and at the same time salve the conscience, there is little problem in writing a final evaluation report. But, if an absolute criterion is used to determine the success of a program it becomes necessary to ask oneself, "Irrespective of how the participant came to me can he now propose, conduct, and evaluate an instructional experiment?" If he can, or if they can, the program was a "success." If he cannot, or if he is below some arbitrary but behaviorally defined critical point, then the program was a "failure."

In the above context this institute was successful, moderately beneficial, and a failure. Some were able to meet the objectives with no further instruction, some needed more help, and a few would be unable to benefit from help if it were provided. The next few paragraphs will summarize the activities of the Institute with the purpose of ferreting out a few reasons for the success and failure of the program.

A. Participants

We were quite successful in screening the applicants for homogeneity of professional activity. As shown in Section IV, D, 2 and IV, F, 19 of the 25 were in positions of curriculum responsibility. Inspection of the "Problems of Participants" shown in Appendix B indicates considerable communality of interests and problems. Results of the administration of the Miller Analogies Test on the first day of the Institute indicate that as a group the participants are representative of graduate students in school administration. However, the raw score range from 29 to 74 is indicative of considerable variability.

Although the ability range represented a troublesome aspect, of greater concern was the tremendous heterogeneity in professional preparation and background. It was unrealistic to assume instructionally that all of them possessed a common and adequate entering repertoire. We attempted to "smooth the curve" by formalizing the laboratory to include a set period for discussion of points not considered germane to the Institute, but were a necessary part of the entering behavior. This, plus the natural regression tendencies in the lecture discussions, helped to keep everybody in the same "park."

Editorially, I should say that to take care of this problem I would not suggest a more precise selection procedure. Rather, I would suggest a more refined set of instructional strategies. Irrespective of inadequate entering behavior, these professionals are the ones who want and need help.

B. Courses

1. Experimental Analyses of Learning and Instruction

Instructor, Howard Sullivan

The individual who wishes to write a good research proposal, select an appropriate experimental design, employ good experimental procedures, and properly interpret research data must possess certain requisite skills. Course I was designed primarily to develop in the participants these requisite skills. The institute program was conducted in such a way that the skills acquired in Course I were applied by the participants concurrently and subsequently in many of the activities and products of the other two institute courses.

Objectives. The objectives of Course I, stated in terms of the desired behaviors to be acquired by the participants, were as follows:

1. Distinguish between types of educational experiments and other forms of professional endeavor.
2. Distinguish between valid and invalid statements of inference about experimental variables when given descriptions of the variables, experimental procedures, and data.
3. Define the expected outcomes of learning and instruction in terms of observable behavior amenable to experimental investigation.

4. Specify the components of instruction essential to the attainment of stated learning outcomes.

5. Construct criterion measures appropriate for measuring attainment of stated learning outcomes.

Activities. The activities in Course I were designed to implement the objectives listed above. Lectures and exercises were developed for each of the listed objectives, and laboratory time for the course was devoted to activities in which participants practiced and refined the relevant skills.

The learner who attains the first two objectives for Course I must be able to employ descriptive information about educational research studies to identify the types of studies described and the relationships that can be inferred from each study. Exercises were developed to provide practice in identifying types of studies and valid inferences, based upon the rules presented in class for making such identifications. The "Exercise on Valid Inferences" presented in Appendix D provides an example of the type of laboratory activity related to the first two objectives.

Objective 3 for Course I related to defining the outcomes of learning and instruction in terms of observable behavior. Initial activities pertaining to this objective involved use of a tape-filmstrip presentation (Popham, 1965) and accompanying materials requiring participants to discriminate between behavioral and non-behavioral objectives. Subsequently, participants constructed their own statements of objectives, employing terms from A Behavioral Taxonomy of Instructional Objectives (Appendix E) to describe a variety of instructional tasks.

The Instructional Specification (IS) approach (Schutz, Baker, and Gerlach, 1964; Schutz, Baker, Sullivan, and Gerlach, 1966) served as the vehicle for implementing the final two objectives for Course I. Participants constructed

IS's for instructional objectives requiring simple and complex discriminations, the performance of mathematical computations, and for behavior involving the application and interpretation of rules. The IS is a straightforward approach for stating the stimulus conditions essential for learner attainment of specified instructional objectives, and it also provides a framework for generating valid test items to measure attainment of the objective. Participants constructed criterion tests for stated objectives by generating test items from the elicitor and stimulus limits sections of the IS.

Outcomes and Evaluation. The outcomes of Course I related to the five stated objectives can best be described in terms of participant performance on the midterm and final examinations. The midterm examination was designed primarily to measure the degree of mastery of the first three objectives of the course and certain behaviors whose acquisition is prerequisite to the attainment of these objectives. Twenty of the twenty-four participants (83%) earned a score of 32 (76%) or higher on the 42-item midterm. Data on items measuring specifically the behaviors stated in Objectives 1-3 revealed that over 79% of the participants scored above 80% on these items. This performance indicates a high degree of learner attainment of Objectives 1-3.

The final examination (Appendix B) covered Objectives 4 and 5 for Course I. Participants specified the stimulus conditions essential for attainment of a stated learning outcome by constructing an IS for a given task. In addition, they constructed a pretest and criterion posttest for this task. It is not possible to quantify the participants' performance on the final examination as precisely as their performance on the midterm can be quantified. The instructor for Course I judged that a majority of the students showed very good performance on the test material relating to Objective 4 (item 1) and good performance on the material related to Objective 5 (item 3).

The evaluation of a course must consider both the extent to which the course objectives were attained and the usefulness of the objectives to the participants. In the instructor's judgment, Course I was highly successful when attainment of objectives serves as the basis for evaluation. This judgment is based primarily upon the examination results described above. An estimate of the usefulness of course objectives, on the other hand, frequently must be based on informal observations and judgments of past and present student behavior. The instructor's appraisal of the usefulness of the objectives in Course I is that Objectives 1-3 were highly useful, but Objectives 4 and 5 were not as useful in a research institute for school curriculum personnel as had been anticipated prior to the institute.

Objectives 4 and 5 would be most useful for individuals who become directly involved in preparing curriculum materials and/or criterion tests for research projects or in supervising the preparation of such materials. Observation of the institute participants suggests that curriculum directors and other administrative personnel in curriculum-related positions normally neither become involved nor intend to become involved in the development of curriculum materials. Instead, they wish to use materials that are already prepared and, whenever possible, assess their effectiveness with existing instruments. There appears to be relatively little desire among school curriculum personnel to assume any direct responsibility for the development or valid assessment of curriculum materials. The participants were enthusiastic over the material related to Objectives 4 and 5 primarily for its applicability to classroom instruction procedures rather than its utility in curriculum research and the development and evaluation of curriculum material.

The five stated objectives for Course I pertain only to the cognitive outcomes of instruction. No systematic attempts were made to develop specific affective outcomes in the participants, although favorable attitudes and judgments toward the course and the concepts covered in it are certainly an important desired instructional outcome. Three items (# 3, 6, and 20) on the Sentence Completion Scale (Appendix F) administered on the final day of the institute were included to assess participant judgments and attitudes toward Course I and its subject matter. The responses to these items indicated that the majority of the participants held highly favorable attitudes toward Course I and the key concepts from the course.

2. Principles and Procedures for Experimentation

Instructor, Vernon Gerlach

If an experiment in school learning is to be conducted in a professional manner, the experimenter must be able to plan his experiment and he must be able to describe both the plans and the outcomes in an acceptable form. This course was concerned primarily with this kind of "writing behavior." It was structured in such a way that it provided an opportunity for the participants to apply knowledge and skill acquired in the other two courses to a specific problem of interest to the participant.

Objectives. This course attempted to develop in the participants the following skills and abilities:

1. Writing a research proposal which accurately describes the plan of the research project.
2. Describing the experimental operations of the project.
3. Describing the characteristics of a report which describes the results of the experiment.
4. Interpreting the results of an experiment, with special emphasis on implications for further experimentation.

Activities. Lectures and exercises designed to enable the participants to acquire the behaviors specified above were prepared. Some laboratory time was utilized by the participants in the acquisition of the specified behaviors.

The learners examined published research reports and practiced identifying those which described an educational experiment. They discussed educational problems which were of concern to them, and they identified, and eventually formulated, problems amenable to study in an educational experiment. Methods of investigating a problem were discussed in lectures. Participants practiced stated objectives and hypotheses, describing procedures, and selecting an experimental (or quasi-experimental) design and techniques of analyzing data.

The exercises (sample included in Appendix G) led the participants through several increasingly more complex attempts at proposal writing. The culminating activity demanded of the student a finished research proposal.

In addition to Krathwohl's (1966) guide to proposal writing, participants were given guidelines for proposal preparation and submission from several governmental funding agencies. These guidelines provided an outline for the proposal as well as criteria which each participant could use to evaluate his product prior to handing it in.

Outcomes and Evaluation. The quality of the final proposals which the participants wrote ranged from the highly acceptable to the completely unacceptable. This, of course, could have been predicted. Three raters read the proposals and rated them 1 (needs no further work), 2 (basically okay, but could be improved with a small degree of attention to ...), or 3 (either needs considerable revision or is basically unacceptable) on the following checkpoints:

(a) Problem Statement
(b) Related Research
(c) Objectives
(d) Procedures
(e) Personnel, Facilities, Budget, and Abstract

Only two proposals received a majority of "3-ratings" from the evaluators, while nine received a majority of "1-ratings." The quality of the proposals exceeded our pre-institute expectations and predictions. The majority of the proposals represented very good efforts and could indeed be used as a guide to an acceptable educational experiment with little or no revision. Furthermore, individual conferences with the participants provided evidence which leads us to believe that the participants can do a highly effective re-write, given minimal cues concerning an area of weakness.

Suggestions for Future Institutes. If the Institute were to be repeated, it seems clear now that two changes should be made to heighten the effectiveness of Course II:

(1) Exercises should be constructed in which the participant is given a problem and a set of data. He should practice describing a design and statistical treatment amenable to the problem and the data. These exercises should become increasingly complex, until the participant can perform in the abstract (i.e., in the absence of concrete data).

(2) Means of applying designs and treatments to the participants' problems should be made more effective. It is possible that the design and statistics course should be brought to a conclusion earlier and that the final portions of Course II should be delayed until the last two weeks of the Institute. To illustrate, a student who had a problem and data for which an analysis of covariance was appropriate either had to master this technique "on his own" or he had to wait until the last week of the Institute. The former is undesirable for several obvious reasons. The latter leaves him no time to integrate his newly acquired skill into a proposal. Though similar examples could be adduced in connection with Course I, the timing of Courses I and II is less critical than the timing of Courses II and III

3. Experimental Design and Statistical Analysis.
Instructor, Robert Baker

An empirical data foundation concerning changes in the behavior of students who are undergoing particular curriculum treatments is the sine qua non of effective decision making. Through the curriculum researcher the chief administrative officer must be able to make objective and valid decisions about instructional materials and programs. Historically, curriculum specialists have lacked methodological competence. Consequently, experimental research in the school setting has been absent or conducted loosely under the banner "action research." Unfortunately, the conventional route to methodological competence has been long, laborious, and ultimately unproductive. Curriculum specialists have avoided experimental design considerations because they thought them to involve a level of specialization beyond the scope of their training. Thus, few systematic evaluation efforts are consumated.

Objectives. The specific behavioral objectives for this course were:

1. Select the most valid and practical experimental design for investigating a given functional relationship.
2. Select the most appropriate statistical procedures for analyzing the experimental data.
3. Perform the necessary statistical analyses using the most appropriate computing vehicle (by hand, desk calculator, punch card processing, electronic data processing) depending upon the extent of the data or the complexity of the analyses.

It should be noted that the behavioral aspects of the above objectives avoid theoretical and conceptual points which are not directly related to the functions which the practitioners must perform. Avoidance of the "humanities" and "general education" aspects afforded potentially great time savings.

Activities. The experimental design and statistics considerations were broken down into short instructional notes. Each note contained the substantive parts of a fairly homogeneous response class, a definable procedure, or a mastery exercise. In general each note contained expository material sufficient to direct the participants' progress. At this stage in development the materials were not sufficiently "self-contained" to enable the participant to monitor his own performance. This remained the task of the instructor. The notes were still quite dependent upon the instructor for full explication.

A typical instructional cycle included the following:

(1) At the end of day 1 the instructor handed out an instructional note.

(2) During the open lab on day 1, participants read the instructional note.

(3) The instructional note (see Appendix H for a sample) includes the substantive materials as they relate to an exemplar problem. The exemplar problem develops sequentially as the notes produce additional information. The responses, if any, required during the first reading are heavily cued.

(4) On day 2 the instructor explicated the note using a new exemplar problem. Responses were less heavily cued, but were supported enough to remain as "error-free" as possible.

(5) At the end of day 2 the instructor handed out the mastery exercise, or next note, which included a third exemplar problem or problems.

(6) The exercise was completed independently. However, the supervised laboratory was organized to cue participants who were having difficulty. This is necessary to maintain a group-paced instructional system.

(7) At the end of a predetermined series of notes an "off-line" exercise covering the objectives was administered to the student (See Appendix I).

Outcomes. In general all objectives were achieved, en route. Of course, the strength of their responses could be questioned. Final posttest results indicate that their general level of response at the end of all instruction was adequate, but not absolute. A copy of the objective examination is in Appendix B. Six of the 47 items were not scored, but an additional three short answer items maintained the total possible score at 47. Following are the descriptive data:

Mean raw score = 32.5
Standard deviation = 4.34
Reliability (KR-20) = .66
Standard error = 3.54

Pretest data are not available since sample items of the posttest were administered early in the eight-week session with no one able to exceed a chance score. We assumed that their entering repertoire included very little of what the posttest was measuring.

Inspection of the results of the Institute Concept Rating Sheet and Participant Critique Form reveal that the procedures used were quite popular (Appendix J, 1 and 2). However, in terms of control and participant monitoring the notes must be developed into a more "self-contained" package. That is, much of what was left to the instructor and laboratory supervisors should be included in the materials.

4. Laboratory.
Supervisors, Howard Sattler and Patrick Slattery

The purposes of the laboratory were to:

1. Insure that the participants understood the largely intra-verbal lecture experiences.
2. Provide activities that helped to integrate the lecture material taught in the three research courses.
3. Insure that each participant was given sufficient instruction in contemporary data processing techniques such that he could:
    a. select the proper computer data processing program.
    b. supervise personnel in preparing a data deck to submit to the computer center.
    c. make contact with the computer center to accomplish processing of the data.
    d. properly interpret and report the computer output.
4. Provide short lectures to support and supplement the major course lectures.
5. Give all participants contact with lab assistants so that individual problems could be resolved.

Laboratory activities consisted of:

1. Designing experiments.
2. Writing proposals.
3. Writing instructional specifications.
4. Working through ANOVA exercises employing the functional "Rules of Thumb."
5. Completing exercises supplementary to ANOVA:
    a. Tests of significance.
    b. Neuman-Keuls.
    c. Analysis of covariance.
    d. Blocking.
6. Analyzing data through the use of the ASU Computer Center.

Specific outcomes related to the laboratory activities and objectives were the following:

1. Writing designs and justifications for experimental design exercises.
2. Writing acceptable proposals.
3. Completion of ANOVA exercises using "Rules of Thumb."
4. Obtaining completed computer printouts for the following exercises:
    a. Keypunch.
    b. Descriptive statistics.
    c. Analysis of variance.
5. Most other lecture assignments from courses I-III were completed during laboratory time.

In general, time was utilized according to the following schedule:

Laboratory Daily Time Schedule

30 minutes - Brief lecture

30 minutes - Data processing

120 minutes - Participants' time to consult with lab assistants concerning any class assignments.

Depending upon the type of assignment there was considerable variation in the specific time allotments. However, in the main the above breakdown obtained.

Probably the most difficult aspect of the laboratory was the peak work load which seemed to occur unexpectedly and could not be controlled by the lab assistants. It became difficult at times for the two assistants to give adequate individual attention to participants' problems. Such problems were relieved by calling for emergency assistance. Coordinating the work load cannot be overemphasized as a pre-institute consideration.

Three major problems seemed to exist in teaching institute members to use computer facilities in processing data:

(1) Some of the institute members had no access to computer facilities in their local school systems.

(2) Not all of the necessary data analysis programs were available to the ASU Computer Center at the time of the institute.

(3) Since computer input language and programs are changing rapidly, it was difficult to teach one method of data analysis and be assured of universal application.

If these three problems could be overcome, it would seem to be desirable to provide a more thorough and comprehensive set of experiences in computer data processing techniques. It is believed that such a program could be used to replace much of the formal instruction on statistical techniques. The important statistical concepts should remain, but to the practitioner much of the time devoted to techniques is of questionable value. Of greater importance would be the availability of a "program library" and the wherewithal to use it.

Other than for the scheduling and data analysis problems mentioned, the laboratory functioned quite effectively. Attendance was excellent. Approximately 80% of the participants attended regularly the voluntary lab sessions.

C. Consultants

Although the consultants' topics were directly related to the objectives of the Institute, previous experience has told us that to attempt "on-line" integration with the rest of the program is futile. We treated the lecturers as "off-line"--as a source of additional new ideas beyond those being presented by the regular instructional staff. The lecturers were also available for individual consultation. In general, the lecturer was present for two days. He made two formal presentations and was available for informal consultation. Inspection of Appendix J,2 indicates that the consultants were extremely well received.

Following are the consultants' names, topics, and dates present:

Name	Dates	Topic
Dr. Julian Stanley	June 23-24	Quasi-Experimental Designs
Dr. Wm. Rabinowitz	June 30 July 1	Experimentation in School Settings
Dr. W. J. Popham	July 5-6	A Generalized Instructional Model and Developments in Curriculum and Instruction
Dr. Richard Schutz	10 days	Relationship Between Educational Research and Educational Development
Dr. Harry Silberman	July 14	Instructional Technology
Dr. Robert Stake	July 18-19	Curriculum Evaluation
Dr. Richard Dershimer	July 25-26	Federal Program Network

IV. STATISTICAL INFORMATION FOR USOE

A. Personal Data

Name and Home Address	Social Security Number	Pre-Institute School Address
Clark, Keith 1202 Whitehouse Dr. Colorado Springs, Colo.	523-42-0184	School District #1 Colorado Springs Colorado
Dawson, Glenn 40 SW 89th Beaverton, Oregon	540-22-3450	Beaverton Sch. Dist.#48 303 E. Erickson St. Beaverton, Oregon
Dudley, Gerald 640 Woodcliff Dr. South Bend, Indiana	313-38-4240	South Bend Comm.Sch.Corp. 228 S. St. Joseph St. South Bend, Indiana
Eaton, Larry 8710 Oakmont Court Omaha, Nebraska	506-34-6292	Bellevue Sr. H.S. Bellevue, Nebraska
Flanagan, Sister Dorothy 134 S. Elm St. Waterbury, Connecticutt	043-22-9921	Waterbury Catholic H.S., Inc. Waterbury, Connecticutt
Griffin, James 317 Milton Ave. Crowley, La.	436-32-2648	Acadia Parish School Board Crowley H.S. Crowley, La.
Harris, Harvey 3300 SW Ridgewood Rd. Portland, Oregon	544-01-8679	Beaverton Sch. Dist. 303 E. Erickson St. Beaverton, Oregon
Hartnett, D. Paul 2110 Van Buren Bellevue, Nebraska	505-30-0868	Bellevue Pub. Sch. Bellevue, Nebraska
Helms, David 14 Alcott Dr., Heritage Park Wilmington, Delaware	221-12-9706	The Tatnall School, Inc. Wilmington Delaware
Hyytinen, Robert Rt. 2, Box 702A Mound, Minnesota	469-38-6573	Independent Sch. Dist. 277 Mound Minnesota
Long, Thomas 1833 Crawford Ave. Altoona, Pennsylvania	178-24-2922	Altoona Sch. Dist. Altoona Pennsylvania
Lyon, Kenneth 1695 Reed St. Fontana, California	529-12-2411	Fontana Unified Sch. Dist. 9680 Citrus Fontana, California

Name and Home Address	Social Security Number	Pre-Institute School Address
Kaufman, Samuel 300 E. Homestead Ave. Palisades Park, N. J.	206-14-0909	Neward State College Union New Jersey
Kirby, Milton 1403 Yale Avenue Brownsville, Texas	454-30-0142	Brownsville CISD 1102 E. Madison Brownsville, Texas
Maus, Minard 682 Mill St. Ely, Nevada	501-18-4578	White Pine Comm. Sch.Dist. Box 400 East Ely, Nevada
Michaud, Arnaud Rt. 1, Box 231 Deep River, Conn.	718-01-3995	Reg. District #4 Deep River Connecticutt
Moon, Robert 112 N. George Berrien Springs, Mich.	555-50-7765	Andrews University Berrien Springs Michigan
Nugent, Frank 9101 Urbandale Ave. Urbandale, Iowa	514-09-5017	Urbandale Comm. Sch. Urbandale Iowa
Pritchard, Selma 1409 Lafayette Ave. Rocky Mount, N.C.	239-58-3364	Craven Co. Board of Educ. P.O. Box 987 New Bern, N.C.
Randall, James 18 Hemingway St. Branford, Conn.	224-28-1922	Board of Education Madison Connecticutt
Retson, James 1409 W. Taylor St. Appleton, Wisconsin	398-16-1162	Board of Education Appleton Wisconsin
Schaeffer, Donald 2020 St. Clair Ave. Brentwood, Missouri	500-1806105	Brentwood Sch. Dist. 8809 Litzsinger Rd. Brentwood, Missouri
Sica, Morris 1750 Larkspur Dr. Placentia, Calif.	119-01-2516	California State College Fullerton California
Williams, James 1105 Pyramid Dr. Las Vegas, Nev.	530-12-4274	Clark Co. Sch. Dist. P.O. Box 551 Las Vegas, Nevada
Wilson, William 160 S. 1st St. St. Helens, Oregon	541-18-6908	School District #502 215 S. 2nd St. St. Helens, Oregon

B. Distribution of Miller Analogies Test Raw Scores

Raw Score	Number	Cumulative Number	Cumulative Percentage
70-74	4	25	100
65-69	1	21	84
60-64	3	20	80
55-59	2	17	68
50-54	3	15	60
45-49	3	12	48
40-44	5	9	36
35-39	1	4	16
30-43	2	3	12
-- 29	1	1	04

Raw Score Mean	51.00
Standard Deviation	13.38
Reliability (KR-20)	.90

C. Application Summary

1.	Approximate number of inquiries from prospective trainees (letter or conversation)	160
2.	Number of completed applications received	105
3.	Number of first rank applications (Applicants who are well-qualified whether or not they were offered admission)	51
4.	How many applicants were offered admission	25

D. Trainee Summary

1.	Number of trainees initially accepted in program	25
	Number of trainees enrolled at the beginning of program	25
	Number of trainees who completed program	24

2. Categorization of trainees

1. Number of trainees who principally are elementary or secondary public school teachers	1
2. Number of trainees who are principally local public school administrators or supervisors	20
3. Number of trainees from state education groups	1
4. Number of trainees from colleges or universities, junior colleges, research bureaus, etc., (specify) University 2 Research bureau 1	3

E. Program Director's Attendance

1. What was the number of instructional days for the program?	39
2. What was the percent of days the director was present?	100

F. Professional Responsibility

Level	Teacher	Curriculum Supervisor	Principal	Other	Total
Elementary	2	5	4	Guidance (2)	13
Secondary			4		4
District		1		Superintendent (5)	6
College	2				2

G. General Information

1. Number of participants from each state

State	Number	State	Number
California	2	Missouri	1
Colorado	1	Nebraska	2
Connecticutt	3	New Jersey	1
Delaware	1	Nevada	2
Indiana	1	North Carolina	1
Iowa	1	Pennsylvania	1
Louisiana	1	Oregon	3
Michigan	1	Texas	1
Minnesota	1	Wisconsin	1

2. Age groupings.

Age Bracket	Number
50-54	2
45-49	5
40-44	8
35-39	5
30-34	4
25-29	1
20-24	0

3. Number of male and female participants.

Male	23
Female	2

4. Marital Status.

Single	6
Married	19

5. Number attending previous NDEA Institutes. 0

6. Participants and size of school and district represented.

Number of Pupils	School	District
4000 - up	9	17
2000 - 3999	3	7
1500 - 1999	2	1
1000 - 1499	1	
500 - 999	7	
100 - 499	3	

7. Academic status and teaching status.

	Elementary		Secondary		K - 12	
Degree Status	Teacher	Supv.	Teacher	Supv.	Teacher	Supv.
Bachelor's	-	-	-	-	-	-
Master's	1	6	1	6	-	7
More than Master's	-	-	-	3	-	1

8. Number of participants from public and private schools.

Public	21
Private	4

9. Years of teaching experience.

Less than 3 - 0

4 - 5 - 1

6 - 10 10

More than 10 - 14

10. Participants working for academic credit.

Credit	25
No credit	0

11. Participants working for degrees.

Working for degree	17
No degree	8

12. Participants applying to other NDEA Institutes

No other institute	15
One other	5
Two others	5

APPENDIX A

Eight Week Institute Schedule

Institute Schedule
First Week
June 13-17

	8:30-9:50	10:10-11:30	11:30-1:00	1:00-2:20	2:30-3:50
Monday	General Orientation				
Tuesday	Course I Sullivan	Course III Baker	Lunch	Course II Gerlach	Laboratory
Wednesday	Course III Baker	Course III Baker	Lunch	Laboratory	
Thursday	Course I Sullivan	Course II Gerlach	Lunch	Data Processing Laboratory Sattler & Slattery	
Friday	Course I Sullivan	Course II Gerlach	Lunch	Data Processing Laboratory Sattler & Slattery	

Institute Schedule
Second Week
June 20-24

	8:20-9:50	10:10-11:30	11:30-1:00	1:00-2:20	2:30-3:50
Monday	Course I Sullivan	Course II Gerlach	Lunch	Laboratory	
Tuesday	Course I Sullivan	Course II Gerlach	Lunch	Laboratory	
Wednesday	Course I Sullivan	Course II Gerlach	Lunch	Data Processing Laboratory Sattler & Slattery	
Thursday	Course III Baker	Course I Sullivan	Lunch	Quasi-Experimental Designs Julian Stanley	Laboratory
Friday	Quasi-Experimental Designs Julian Stanley	Course III Baker	Lunch	Laboratory	

Institute Schedule
Third Week
June 27-July 1

	8:30-9:50	10:10-11:30	11:30-1:00	1:00-2:20	2:20-3:50
Monday	Course III Baker	Course II Gerlach	Lunch	Laboratory	
Tuesday	Course III Baker	Course I Sullivan	Lunch	Laboratory	
Wednesday	Course III Baker	Course II Gerlach	Lunch	Laboratory	
Thursday	Course III Baker	Course I Sullivan	Lunch	Experimentation in School Settings Dr. Rabinowitz	Laboratory
Friday	Course I Sullivan	Course II Gerlach	Lunch	Experimentation in School Settings Dr. Rabinowitz	Laboratory

Institute Schedule
Fourth Week
July 5 - 8

	8:30-9:50	10:10-11:30	11:30-1:00	1:00-2:20	2:30-3:50
Monday	Holiday				
Tuesday	Course III Baker	Course II Gerlach	Lunch	A Generalized Instructional Model Dr. Popham	Laboratory
Wednesday	Course III Baker	Course I Sullivan	Lunch	Developments in Curriculum and Instruction Dr. Popham	Laboratory
Thursday	Course III Baker	Course I Sullivan	Lunch	Laboratory	
Friday	Course I Sullivan	Course II Gerlach	Lunch	Mid-Term Examination	

Institute Schedule
Fifth Week
July 11 - 15

	8:30-9:50	10:10-11:30	11:30-1:00	1:00-2:20	2:30-3:50
Monday	Course III Baker	Course I Sullivan	Lunch	Laboratory	
Tuesday	Course III Baker	Course II Gerlach	Lunch	Laboratory	
Wednesday	Course III Baker	Course I Sullivan	Lunch	Laboratory	
Thursday	Course III Baker	Instructional Technology Dr. Silberman	Lunch	Course II Gerlach	Laboratory
Friday	Course I Sullivan	Course II Gerlach	Lunch	Laboratory	

Institute Schedule
Sixth Week
July 18 - 22

	8:30-9:50	10:10-11:30	11:30-1:00	1:00-2:20	2:30-3:50
Monday	Course III Baker	Course II Gerlach	Lunch	Curriculum Evaluation - Dr. Stake	Laboratory
Tuesday	Course III Baker	Curriculum Evaluation Dr. Stake	Lunch	Course I Sullivan	Laboratory
Wednesday	Course I Sullivan	Course II Gerlach	Lunch	LABORATORY	
Thursday	Course III Baker	Course I Sullivan	Lunch	LABORATORY	
Friday	LABORATORY				

Institute Schedule
Seventh Week
July 25-29

	8:30-9:50	10:10-11:30	11:30-1:00	1:00-2:20	2:30-3:50
Monday	Course III Baker	Course II Gerlach	Lunch	Federal Program Network Dershimer	Laboratory
Tuesday	Course III Baker	Course I Sullivan	Lunch	Federal Program Network Dershimer	Laboratory
Wednesday	Course I Sullivan	Course II Gerlach	Lunch	LABORATORY	
Thursday	Course III Baker	Course II Gerlach	Lunch	LABORATORY	
Friday	LABORATORY				

Institute Schedule
Eighth Week
August 1-5

	8:30-9:50	10:10-11:30	11:30-1:00	1:00-2:20	2:30-3:50
Monday	Course III Baker	Course II Gerlach	Lunch	Laboratory	
Tuesday	Course III Baker	Course I Sullivan	Lunch	Laboratory	
Wednesday	Examination Course III Baker	Examination Course I Sullivan	Lunch	Examination Course II Gerlach	Laboratory
Thursday	Laboratory	Course III Baker	Lunch	Course I Sullivan	Course II Gerlach
Friday	Institute Evaluation		Lunch	Highway Briefing	

APPENDIX B

Final Quizzes for the Three Courses
(Written Portions)

Educational Research Institute
Classroom Learning Laboratory
Arizona State University

Final Exam

Course I

1. Assume that you are teaching (or developing instructional materials for) a class of teacher trainees who have not previously heard the term "behavioral objective."

   Construct an IS to use with these students to develop the following behavior:

   To construct (write) statements of behavioral objectives.

   Before constructing the IS, select from the taxonomy the two behaviors that you think it would be most crucial for the learner to acquire toward behavioral objectives before he could adequately construct statements of behavioral objectives. Write your IS for the objective above in such a way that it provides for the acquisition of these two behaviors in addition to the constructing behavior specified above.

   For this item, then, you are to write a single IS that provides for acquisition of the behavior "To construct statements of behavioral objectives," plus the two other enroute behaviors that you select by using the taxonomy.

   In selecting examples and test items for your answers to the 3 items on this test, do not use any examples of objectives that appear on exericises, tests, or any other class handouts. That is, generate (i.e., construct your own examples & non-examples of behavioral objectives, rather than using mine.

2. Construct a 4-8 item pretest for the IS that you developed.

3. Construct an 6-10 item post test to measure each behavior developed in your IS.

Sullivan 8/66

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Course II

Final Examination

(You may use any books, notes and references in this examination.)
In the context of the materials presented in class on Monday, do the following:

1. State a problem. Explain it in such a manner that it is clear what is included and what is left out. Show its significance. Then summarize it, if possible, in a simple sentence.

2. State the objectives (or hypotheses or questions) with which your research is concerned.

3. Define your target population. Describe the sampling procedures.

4. Describe the design and the methods of analyzing your data.

Your time limit for the entire examination is 80 minutes.

Gerlach 8/66

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Arizona State University

Course III

Quiz: A Biased Sample of Items

A particular experimental design involves four factors (independent variables or main effects), each with two levels (groups). All 16 cells appear in this completely crossed experimental design. Assume that there is just one observation in each cell.

Is there an appropriate error term (denominator of F-ratio) for testing the significance of the

	A.	B
1. Main effects	yes	no
2. Two factor interactions	yes	no
3. Three factor interactions	yes	no
4. Four factor interactions	yes	no

The following description pertains to question #2 - #4. Factor A has 2 levels and Factor B has 4 levels. The 12 scores gathered in this experiment are tabulated below:

Factor A	Level 1		Level 4	
Factor B	Level 1	Level 2	Level 3	Level 4
	31	35	34	14
	26	39	14	16
	32	41	32	19

5. In the above design

   A. Factors A and B are completely crossed.
   B. Factor A is nested within Factor B.
   C. Factor B is nested within Factor A.
   D. Factors A and B are neither nested nor crossed.

6. The number of degrees of freedom for the sum of squares for Factor B in the Analysis of Variance of the above design would equal ____. (Fill in the blank with the corect number.)

7. If an experimenter gathered data according to the above plan,

   A. he could not make a significance test for differences between levels 1 and 2 of Factor A.

   B. he could obtain no information from the data about the extent to which Factors A and B interact.

8. In a three-way analysis of variance design in which Factor A has 2 levels, Factor B has 4 levels and Factor C has 5 levels and in which all three factors are completely crossed (i,e., all 40 possible combinations of levels appear), the number of degrees of freedom for the interaction of Factors B and C is _____. (Fill in the blank with the correct number.)

9. The 3 levels of the factor " mental ability" in an experimental design are defined by the experimenter to be High (IQ above 110), Average (IQ between 90 and 110), and low (IQ below 90). Generally, such a factor for the purpose of performing an analysis of variance would be regarded as a

A. Fixed factor
B. Random factor
C. Finite factor
D. Crossed factor
E. Nested factor

10. When the results of an experiment are true only under certain veryspecial conditions and do not generalize far beyond the particular experimental conditions, the experiment is said to have

A. low internal validity.
B. high internal validity.
C. low external validity.
D. high external validity.

11. Which one of the following is usually considered a threat to the internal validity of an experiment?

A. Interaction of Testing and Treatments
B. Multiple Treatment Interference
C. Regression
D. Reactive Arrangements

12. Which one of the following is not usually considered a threat to the internal validity of an experiment?

A. Maturation
B. Testing
C. Reactive Arrangements
D. Regression
E. Mortality

13. Suppose you are studying the effect of "emotionality" in a speech. For purposes of generalization of X, which is preferable? Use

A. a tape recorder with the speech set.
B. one speaker,,delivering same speech in same way.
C. different speakers delivering speech in practiced way.
D. different speakers interpreting speech in a variety of ways.

14. In classroom experiments where achievement in a subject is the criterion, which solution best answers the problem of biased assignment and unique intragroup histories?

A. Moving the randomization to classroom as unit.
B. Setting up randomization procedures to assign students to classes at the beginning of fall semester.
C. Blocking on the basis of individual student ability.
D. Applying analysis of convariance to individual student ability.
E. Use of the within-class variance as error term.

15. For educational experiments where randomization is possible, what is the preferred policy regarding pre-tests which are related closely with the post-tests?

A. Almost always preferred
B. Usually preferred
C. Usually not preferred

16. Where random assignment is not possible but groups are tested in situations where "nature" has run the experiments, the experimenter has the duty of

A. denying any causal relationship in his data.
B. examining any rival explanations of the data.
C. stating his assumption that any other influences are randomly distributed among "treatments."
D. finding other educatonal problems to investigate.

17. Suppose you need to run an experiment in which one of the treatments (a field trip) requires the permission of parents. What is the best procedure?

A. Have alternate students standing by to replace any who are unable to secure permission of parents in that treatment group.
B. Let the students go but assess the loss by dropping those students who seemed like the no-shows in the relevant variables.
C. Secure permission from all possible parents before the experiment, and before assignment of students to treatments.
D. Assume that drop-out is random and disregard dangers in the analysis.

18. Suppose you have two intact classes available, both taught by the same teacher, and wish to test the efficacy of a particular visual aid in instruction. For each unit through the semester the aid is assigned randomly to one class or the other. At the end of a semester, the units taught by visual aid are significantly superior to those taught without. You can generalize the results to presence of the aid in general under which of the following assumptions?

A. No interaction exists between treatments and any of the specifice variables such as teacher, or class, etc.
B. This teacher is an average teacher and the class is an average class.
C. No interaction exists between maturation and history.
D. The classes, although intact, are essentially equivalent.

19. The notation for "factor B nested within factor A" is

A. B:A.
B. A:B.
C. AB:R.

20. The notation for "factor R nested within combinations of factors C and D" is

A. R:CD.
B. CR:D.
C. C:RD.
D. CD:R.
E. D:CR.

21. C is nested within D and A is nested within B. The notation for "interaction of A and C" is

A. AC.
B. AC:BD.
C. AB:CD.
D. CD:AB.
E. DB:AC.

22. Factor C is nested within factor E. Factor E is denoted by

A. C:E.
B. E:C.
C. E.

23. In a completely corssed ANOVA design with 4 factors, there is a total of _____ interactions involving 2 or more factors.

A. 4
B. 8
C. 11
D. 12
E. 16

24. In enumerating the possible sources of variation in a design with factors A, B, C:A, D, E:B, the interaction of C and E would be written

A. C:AE:B.
B. CB:AE.
C. CE.
D. CE:AB.
E. AB:CE.

25. Given the facors listed in #24 above, which one of the following sources of variation should be eliminated from the ANOVA table bacause it does not exsist.

A. CD:A.
B. AE:B.
C. DA.
D. ABD.
E. CBD:A
F. BE:B.

26. R ("replications") is always regarded as a random factor nested within all combinations of the other factors in the design.

A. only two factor-interactions involving R can occur.
B. No interactions involving R can occur.
C. Only the interaction of R with all of the other factors in the design can occur.

27. The number of degrees of freedom for the interaction of A and B in a two-way ANOVA is

A. 2.
B. 1.
C. 4.
D. None of the above, necessarily.

28. In a particular three-way ANOVA, a = 10 and C = 2. The no. of d.f. for AC is

A. 20.
B. 10.
C. 18.
D. 19.
E. 9.
F. Not necessarily any one of the above.

29. The d.f. for AC:D are

A. ac(d - 1).
B. (a - 1) (c - 1) (d - 1).
C. (a - 1) (c - 1).
D. (a - 1) (c - 1) d.

30. The d. f. for A:BC are

A. (a - 1) bc.
B. a(b - 1) (c - 1).
C. (a - 1) (b - 1) (c - 1).
D. abc.
E. (a - 1).

31. The d.f. for R:ABC are

A. rabc.
B. abcr - abc.
C. r(a - 1) (b - 1) (c - 1).

32. The d.f. for AB:C are

A. ab - a - b + c + 1.
B. (ab - 2ab + 1) c.
C. abc - ab
D. abc - ac - bc + c.

33. The computational formula for the sum of squares corresponding to the source of variation denoted ABC has ____ terms.

A. 3
B. 4
C. 6
D. 7
E. 8
F. 9

34. The computational formula for the S S for ABC:DE has ____ terms.

A. 3
B. 4
C. 6
D. 7
E. 8
F. 9

35. The random factor "replications" which is nested within all combinations of the other factors in the design always has ____ terms in the computational formula for S S.

A. 2
B. 3
C. 4
D. Cannot be determined without more information.

36. In a design with factors A, B, C, and R:ABC, the first term in the formula for SS for ABC is

A. $\dfrac{\sum_1^a\sum_1^b\sum_1^c\left(\sum_1^r X\right)^2}{r}$.

B. $\dfrac{\left(\sum_1^a\sum_1^b\sum_1^c\sum_1^r X\right)^2}{abcr}$.

C. $\sum_1^a\sum_1^b\sum_1^c\sum_1^r X^2$.

37. Which one of the following terms is inconsistent with the rules for generating computationa formuals for SS?

A. $\dfrac{\sum_1^d\sum_1^e\left(\sum_1^r X\right)^2}{r}$

B. $\dfrac{\sum_1^a\sum_1^c\left(\sum_1^d\sum_1^r X\right)^2}{dr}$

C. $\dfrac{\sum_1^f\sum_1^h\left(\sum_1^k\sum_1^r X\right)^2}{r}$

38. Which one of the following denotes the variance component for factor E which is nested within combinations of factors B and C?

A. $\sigma^2_{e:bc}$

B. $\sigma^2_{bc:e}$

C. σ^2_{e}

D. σ^2_{bc}

39. A particular design has factors A, B, C, D:A and R:ABCD. In writing the E (MS) for AB, the number of variance components which might possibly exist in the E(MS)--i.e., the number of variance components present before any are deleted by Rule V-B-2- is

A. 2
B. 3
C. 5
D. 7
E. 8

40. Suppose the lines for an ANOVA table are A, B, C, D:A, AB, AC, BC, BD:A, CD:A, ABC, BCD:A, R:ABCD. Which one of the following lines of the ANOVA table would not contribute a variance component to E(MS) for BCD:A?

A. R:ABCD
B. BCD:A
C. ABC

41. For the conditions in # 40 above, the possible variance components for the E(MS) of CD:A come from lines A, C, D:A, AC, CD:A, BCD:A, R:ABCD. Which one of the following from among this set of seven would be eliminated if factor B were fixed and all other factors were random?

A. BCD:A
B. CD:A
C. R:ABCD
D. D:A
E. C

Directions: Mark the most appropriate answer on the line beside each statement using the following code:

"The investigator's alteration of decision to alter some features of the total design would probably

A. increase the power of the statistical test.

B. decrese the power of the statistical test.

C. have no systematic effect on the power fo the statistical test."

_______ 42. An investigator changes his level of significance from the .05 to the .01 level and leaves everything else unchanged.

_______ 43. An investigator changes sample size in each cell from 15 to 20 and leaves everything else unchanged.

_______ 44. An investigator identifies a computational error.

_______ 45. In comparing a new experimental method with a control method, investigator makes appreciable improvements in the new methods between his first study and a subsequent study.

_______ 46. An investigator chooses to use an analysis of convariance rather than a randomized groups design.

_______ 47. An investigator decides to use a different population of experimental subjects which is almost identical to the old population except that the variance of the new population is one half as large as that of the old population.

Baker 8/66

APPENDIX C

Educational Research Institute
Classroom Learning Laboratory
Arizona State University

PROBLEMS OF PARTICIPANTS

Sam Kaufman

I would appreciate a discussion of the consutation help that will be available--kind and amount--before I begin to outline problems. This would be appreciated at an early date.

David Helms

(a) determine the interaction relationship, if any, among teaching styles, learning styles, grouping, and informational vs. inductive learning materials.
(b) determine if arithmetic instruction that focuses upon concepts of operations and number materially improves applications performance vs. drill in computations and applications.
(c) determine if mastery of transformational generator grammar is related to quality to composition vs. traditional grammar.
(d) determine if a survey-porthole inductive development of history improves comprehension and retention vs. traditional, comprehensive text-project instruction.

D. Paul Hartnett

Comparison of teaching methods with the gifted students in grade 8 in subject area of English or language arts.
Gifted: IQ of over 125 and above 85 percentile on local norms on STEP test. Two methods I would like to compare would be self-contained and seminar type. In seminar type, students would be allowed to pursue material more on their own, and more freedom as to attending class, etc.

Keith Clark

My concern is "How does one identify all the variables in a problem to be researched? Is it important to concern ourself with identifying all variables. It seems that to identify all the probable variables would be impossible!

Ken Lyon

Specific research problems -- Relationship between student (first grade) learning abilities and disabilities and method or methods of beginning reading instruction.

James Randall

I have hopes of selling someone on the idea of having a basic skill center in the high school. I am interested also in experimenting with listening skills to determine ways to improve them and to ascertain their relationship with certain other academic skills and achievements, but have no specific problem or design in mind at this time.

Sister Dorothy Flanagan

Yes, I would like to determine the relationship between independent study for seniors in history and English and their achievement in these areas.

Morris Sica

While I do not have a specific research problem, I should like to explore the possibility of doing curriculum research through the medium of computer assisted evaluation.

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William G. Wilson

Specific research problems:
At the present time, my interest centers around three major areas of concern:
(a) problems related to instruction of educationally and/or culturally deprived children, as this group constitutes a sizeable percentage of the district enrollment.
(b) are there arbitrary administrative arrangements for pupil assignment which provide for the most efficient use of teacher instructional time. To some degree principals are guided by circumstances not of their choosing. Which kinds of selectional devices for placing children result in more effective use of teacher instructional time.
(c) it appears that some teachers never individualize their instructional procedures. To what degree are children influenced in terms of school achievement by those who do individualize as opposed to those who do not.
I have not fully developed my ideas regarding these three areas. As of the three, I believe that #3 could be developed to include aspects applicable to numbers one and two.

G. Dudley

1. As a pre-experimental condition, correlational type study was completed last year. The facts gathered were all related to the 591 dropouts from the secondary schools and were divided into some 66 different variables which were responded to by the dropouts prior to their termination from school. All the responses are on IBM cards and need to be treated so that frequencies of each type response may be seen. The results of this study will probably suggest several experimental studies which I could design while at ASU.
2. IBM (punched) cards contain the pre- and post-instrumentation results of a pilot project in elementary school guidance conducted last year. The objectives of the program were specific and the instruments employed were designed to assess change between pre- and post-testing in attitudes toward counselors by students, parents, and faculty. Two control schools were used, one as a control for pre- and post-testing and the other only for post-testing, to evaluate the effects of instrumentation. If I could analyze this data I hope the direction of our experimentation next year may become evident and further research may be designed while here at ASU.
3. During the next school year, it will be my responsibility to chair a committee to evaluate the total testing program (standardized) K-12 in our school. I hope to complete a review of the research while at ASU concerning methods of evaluation which have been conducted. The main objective of our evaluation will center around that information about students a teacher must have in order to individualize instruction which can be most economically gained from standardized testing. I hope to get a start made on an evaluation instrument to do this job while here at ASU.
4. Last year the ninth grade students were evaluated for the first time on non-academic performance. This performance was assessed by means of an IBM card containing 9 factors which describe a student more completely than just academic performance. These factors were each written in continuem form from 1-5 (least desirable to most desirable) and all teachers of each student were asked to assess the student. The results of this survey will be gathered each year and should prove a valuable basis for designing experiments within the corporation. I hope to be able to design one or two experiments using these factors while here at ASU.

James T. Williams

Specific research problems: Principals in Clark County, Nevada, are in an enviable position in that they hold a high degree of autonomy. As a consequence instructional program innovation can be implemented with considerable ease. With this autonomy comes the responsibility to justify to at least four different groups (i.e., students, faculty, parents, and District Administration) the values or outcomes of the program deviation. Sound research design should be most helpful in gathering convincing data for the four groups supporting the values of the innovation, or graphically revealing to the Principal the error of further pursuit of an unsuccessful venture.

Junior High Schools, in my opinion, tend to be the weakest link in the K-12 program of public education. I conclude this from the unsubstantiated observation that teachers migrate to "better" assignments at both elementary or senior high grades from the Junior High School. My conclusion is further strengthened by a shadow study conducted and reported by ASCD in 1963 using some 100 eighth graders from schools throughout the United States. The resulting data revealed a consistent and appalling high level of absolute nothingness in instruction and learning for those shadowed.

The most potent agent for instructional improvement resides in the teacher, in my opinion. School executives, no matter how competent, do not make "good" teachers, but teachers become "good" when provided with reliable and usable data on the success of their efforts with children. Neither committees, rating scales, nor "IOTA" provided the school principal with a completely adequate resource for evaluation and communication. I am strongly interested in the activities of Dr. James Popham at UCLA to use success in meeting specific objectives as a criteria of "goodness" and then applying an investigation of the "theatrics" of a teacher only when success in achieving the objective does not result.

These are three areas I would at some time like to get into. Whether during or at the conclusion of the Institute I will be ready to tackle any one remains to be seen in my growth during the Institute.

Frakk Nugent

We are undertaking a four-year project to compare ITA with programmed reading and traditional developmental reading as instruments for teaching beginning reading and enlarging the writing vocabulary. We had two ITA and eight TO first grade sections last year. Next year and in succeeding years we will have four ITA, two programmed, and five or more TO sections. Teachers are instructed to follow the guides for their program.

I would like to determine three things:
(a) what factors in ITA and programmed reading contribute to apparent easier learning
(b) can these factors be incorporated into the TO programs?
(c) what is the long-range effect?

The following tests were given to first grade pupils: Metropolitan Reading Readiness, Kuhlmann-Anderson Primary Mental Ability, locally prepared word recognition, locally made essay, and Stanford Achievement.

I am also interested in determining whether the EDL Math Builder improves arithmetic achievement. I could try this in three sections of randomly assigned 5th to 9th grades. I am interested in whether it is effective for all pupils or certain pupils, and under what conditions. I could also use two tutorial teachers who work with one to six pupils at a time.

Don Schaeffer

I would like to try to determine whether or not, and how well, a certain programmed book on writing instructional objectives plus planned exercises teacher teachers to write instructional objectives in behavioral terms which define minimal acceptable student performance. Once, if ever, this goal can be reached, then we can begin evaluating the effectiveness of instructional programs. I would like to learn more about individual (independent) instructional devices and techniques and be able to test the effectiveness of them.

Glenn Dawson

I would like to attempt an experimental design to measure the effects of team teaching vs. the self-contained classroom. It must be workable within the framework of my particular situation. I'm also interested in identification of self-concept and what develops it. What + and - values do.

James Retson

I have made some comparisons of non-graded vs. graded organization in terms of achievement of pupils but this is correlational at this point. It would be interesting to experimentally test some other variables involved.

Thomas E. Long

Yes, I would like to begin to develop a proposal to study the effects of 3 year high school computer programming training on the development of traits of systematic approach, logical analysis, problem evolution. I hypothesize that such training will in itself promote such trait development.

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Exercise on Valid Inferences

The exercise below requires you to classify studies on the basis of brief descriptions provided about them and to judge the validity of statements relating to the data provided. For the purposes of this exercise, assume that all differences reported under "Findings" are statistically significant.

A. Outcome: Percentage of students matriculating in college.

Related variable: Number of counseling sessions with high school counselors.

Source of Data: Researcher counts number of sessions recorded (The records are accurate) on each subject's completed high school Counseling Record Card.

Findings: The greater the number of counseling sessions, the greater the number of students matriculating in college.

1. Tell whether this is a status study, a correlational study, or an experimental study. (Key for answer sheet: 1=status, 2=correlational, 3=experimental)

   Tell whether each of the following statements is a valid inference or an invalid inference based on the information given above. (Key for answer sheet: 1=valid inference, 2=invalid inference)

2. The number of students matriculating in college will increase if each student is given an increased number of counseling sessions.

3. More counseling sessions result in greater student matriculation in college.

4. There is a positive relationship between number of counseling sessions and student matriculation in college.

5. Some students matriculate in college because of having an increased number of counseling sessions.

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B. Outcome: Percentage of students matriculating in college

Related variable: Socio-economic status (SES)

Source of data: In the same high school, 100 students are randomly selected from high SES, 100 from meduim SES, and 100 from low SES.

Findings: 82 High SES students matriculate
54 Meduim SES students matriculate
27 Low SES students matriculate

6. What type of study is this?

Valid or invalid inference?

7. Changing the social class of a group of 100 students from low to medium will increase the number of students from that group who matriculate in college.

8. Socio-economic status is positively related to matriculation in college.

9. Some students matriculate in college because they have high socio-economic status.

10. The higher the socio-economic status of a given group of students, the greater the probability that students from the group will matriculate in college.

C. Outcome: Percentage of students matriculating in college.

Related variable: Type of advice about college attendance that a counselor gives to student.

Source of data: Researcher randomly assigns one-third of all high school seniors to Group X, one-third to Group Y, and one-third to Group Z. Counselors tell each Group X student about college and advise each student to attend. Counselors tell each Group Y student about college but do not give advice about whether or not the student should attend. Group Z receives no counseling about college.

Findings: 450 Group X students matriculate.
300 Group Y students matriculate.
300 Group Z students matriculate.

11. What type of study is this?

Valid of invalid inference?

12. Counseling results in an increase in the number of students matriculating in college.

13. More students advised by counselors to attend college matriculate than do students not given counselor advice about whether or not to attend college.

14. Some students matriculate in college because they receive counselor advice to attend college.

15. The number of students matriculating in college will be greater if students are advised to attend college than if they are not given such advice.

D. Outcome: Reading achievement as measured by standardized achievement test for first graders.

Related variable: Type of instruction

Source of data: End-of-year standardized achievement test scores are obtained for 100 first-grade students randomly selected from among all students in the local school system who were taught first-grade reading by the Initial Teaching Alphabet (ITA) method and for 100 first graders randomly selected from among those taught by the traditional (TO) method.

Findings: TO mean score=2.0 (grade-placement norms)

ITA mean score= 2.5

16. What type of study is this?

Valid or invalid inference?

17. Some first-grade students learn better using ITA materials than using TO materials.

18. ITA is a more effective method for teaching reading than TO.

19. Teaching with ITA materials results in better reading achievement than teaching with TO materials.

20. First-grade students taught with ITA materials will achieve better in reading than those taught with TO materials.

E. Outcome: Reading achievement as measured by standardized achievement test for first graders.

Related variable: Sex of student

Source of data: At the end of the school year 100 first-grade girls and 100 first-grade boys are randomly selected from local schools and administered standardized reading achievement tests.

Findings: Girls' mean = 2.3
Boys' mean = 1.9

21. What type of study is this?

Valid or invalid inference?

22. Girls have greater natural ability in reading than do boys.

23. Reading achievement is related to sex of student.

24. Environmental factors (e.g., teaching procedures, appeal of the instructional content, home conditions, etc.) are more conducive to high reading achievement in girls than in boys.

25. Girls have more in-school and pre-school experiences that contribute to reading ability than do boys.

F. Outcome: Reading achievement as measured by standardized achievement tests for first graders.

Related variable: Length of time that the subject crawled in infancy.

Source of data: All first-grade students in the local school system are divided into two groups on the basis of accurate records on their infant development. The end-of-first-grade reading achievement of those who crawled for 3 months or longer (crawlers) before walking is compared with that of students who crawled for less than 3 months (non-crawlers).

Findings: Crawlers' mean = 2.6
Non-crawler's mean = 2.1

26. What type of study is this?

Valid or invalid inference?

27. As a group, children whose parents take sucessful steps to insure that the children crawl for more than 3 months will be better readers at the end of the first grade than children who crawl for less then 3 month.

28. Length of crawling in infancy is positively related to end of first-grade reading achievement.

29. Increased crawling in infancy results in improved end-of first-grade reading achievement scores.

30. Children who crawl for 3 months or longer in infancy are better end-of-first-grade readers than those who crawl for less than 3 months.

G. Outcome: Achievement as indicated by scores on standardized achievement test battery administered at the end of 1965-66 school year.

Related variable: Type of classroom organization.

Source of data: At the beginning of the 1965-66 school y4ar, half the students in a six-grade elementary school are randomly assigned to a team-teaching program and half to a self-contained program.

Findings: Team mean score = 4.7
S-C mean score = 4.4

31. What type of study is this?

Valid or invalid inference?

32. A team-teaching approach results in greater student achievement than a self-contained approach.

33. Students who are taught by a team-teaching approach will achieve better than those taught by a self-contained classroom approach.

34. Greater student achievement is associated with a team-teaching approach than with a self-contained approach.

35. The achievement of students under a team-teaching approach is greater than that of students under a self-contained approach.

H. Outcome: Achievement as indicated by score on standardized achievement test battery administered at the beginning of 1965-66 school year.

Related variable: Type of classroom organization.

Source of data: A standardized achievement test battery is administered to all beginning fourth graders. A mean battery score is computed for all students who had spent grades 1-3 in a non-graded primary, and a mean score is computed for all students who spent grades 1-3 in a graded primary.

Findings: Graded mean = 4.6
Non-graded mean = 4.1

36. What type of study is this?

Valid or invalid inference?

37. If a student attends a graded primary in grades 1-3, he will score higher on a standardized achievement test at the beginning of grade 4 than if he attends a non-graded primary.

38. A non-graded primary approach results in poorer student achievement than a graded approach.

39. Some students obtain higher achievement scores because they attended a graded primary than they would have achieved had they attended a non-graded primary.

40. Greater student achievement is associated with a graded-primary approach than with a non-graded approach.

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A TAXONOMY OF INSTRUCTIONAL OBJECTIVES

The objectives of any project in curriculum and instruction represent a crucial component of the project. The success of a project is determined primarily by the extent to which its objectives have been attained. In addition, the objectives are the primary factor in determining the procedures to be employed during the project. Thus, it is extremely important that individuals responsible for the formulation and implementation of curriculum projects employ the most effective available techniques for specifying instructional objectives.

Experts in educational measurement and curriculum have emphasized the importance of stating instructional objectives in terms of observable behaviors to be performed by the learner. Only when an objective is specified in terms of learner performance can an accurate assessment of its attainment be made. In the assessment process the teacher, the curriculum specialist, the measurement specialist, and other observers must be able to distinguish between learners who exhibit the specified behavior and those who do not. Thus, the evidence of the attainment of an objective must be of such a nature that independent observers agree upon the presence or absence of the behavior. This requires that the behavior be clearly observable and described in terms whose meaning is agreed upon by the independent observers.

While considerable attention has been devoted to the importance of behaviorally stated objectives for measurement purposes, somewhat less emphasis has been placed on another important function of behavioral objectives. The teacher who is attempting to implement a behavioral objective is concerned with the development of a specified criterion behavior in the learner. The teacher may have formulated the stated objective. At the very least, he has read it. He can describe precisely the criterion behavior that the successful learner will perform. The ability to describe the criterion behavior that the learner is to acquire is a necessary condition for enabling the teacher to identify and employ the most effective instructional procedures in developing the desired behavior. That is, the teacher must be able to describe the criterion behavior serving as the instructional objective before he can specify the en route behaviors that the learner must acquire in order to master the criterion behavior. When the teacher has determined the required en route behaviors, he formulates his instructional strategies and begins to systematically develop the en route and criterion behaviors in the learner.

The teacher who is attempting to implement instructional objectives not stated in terms of direct measures of learner performance is under a serious handicap in formulating his instructional procedures. He cannot describe precisely the criterion behavior that the successful learner will perform, nor can he distinguish between individuals who possess the behavior and those who do not. Because he cannot accurately describe the criterion behavior, he is unable to determine the required en route behaviors. Yet, it is essential that he determine precisely both the en route and criterion behaviors if he is to employ efficient and effective instructional procedures to develop these behaviors. He is, therefore, in the anomalous position of attempting to implement an objective whose attainment cannot be accurately assessed, while lacking the information required to determine effective instructional procedures for implementing the objective.

There are three essential characteristics of an instructional objective: (1) the objective must be described as observable performance; (2) the learner, not the teacher, must do the performing; and (3) the objective must be stated in terms whose meaning is agreed upon by independent observers. Many of the words used to state educational objectives do not possess all of the three characteristics above. For example, take such commonly used terms as "to understand," "to know," and "to appreciate." These terms serve an important function in the English language, but their usefulness in statements of instructional objectives is minimized because they fail to satisfy the requirements of characteristics 1 and 3 above. None of these terms defines an observable performance, and it would be difficult for independent observers to agree upon their precise meaning.

If a list of clearly defined action words is used in constructing statements of instructional objectives, the probability that the objectives will possess the three characteristics noted above is increased markedly. Definitions have been developed in the Classroom Learning Laboratory for a list of such words, and the words have been used as performance descriptions in constructing objectives for sets of instructional materials from various subject-matter areas. The desired behavioral outcomes for most instructional tasks can be clearly described with the use of this list. The list of action words and their definitions are provided below.

The Taxonomy

The words below are designed for use as performance descriptions in the construction of statements of instructional objectives. The examples given are items which the successful learner would answer correctly to provide evidence that he had obtained the stated objective.

1. Identify - The learner indicates membership or non-membership of specified objects or events in a single class when the name of that class is given.

   Example: Objective = To identify a peninsula.

   1) On the map before you, is "X" a peninsula? a)yes b)no
   2) Which is a peninsula? a) X b) Y c) Z

   The learner may respond to the examples above by writing or underlining the correct response or by pointing, touching, speaking, etc.

2. Distinguish - The learner indicates the class membership of specified referents belonging to one of two or more classes whose names are given. The referents to be classified must include exemplars from at least two of the given classes.

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Examples: 1) Objective = To distinguish between nouns and pronouns. For each word write (or say) 'noun', 'pronoun', or 'neither'.
a) them b) is c) radio d) car e) when

2) Objective = To distinguish between the eight parts of speech.
Write the part of speech of each word in the passage below. (A list of the parts of speech would be given with this item.)
A big black dog was barking loudly at the children. "Quick!" shouted Mary. "Run and hide from him!"

3. Name - The learner supplies the correct verbal label (in speech or writing) for a referent or set of referents when the verbal labels are not given.

Examples: 1) Objective - To name the eight parts of speech.
List the eight parts of speech.

2) Objective = To name the eight parts of speech, given a passage containing each part of speech.
Write the part of speech of each word in the passage below. (No list of the parts of speech would be given.)
A big black dog was barking loudly at the children. "Quick!" shouted Mary. "Run and hide from him!"

Note that the verbal labels may be supplied for either a generically described class of objects (e.g., the eight parts of speech, the five parts of a flower, etc.) or for specific exemplars of that class (e.g., the name of the part of speech is supplied for each given word or exemplar, rather than simply naming the eight parts of speech but not attaching the name to specific exemplars of each part).

4. Order - The learner arranges two or more referents in the proper order specified in instructions to the learner. The learner may be required to name the referents himself (i.e., to name and order), or a list of referents may be provided for him to order.

Examples: 1) Objective - To order chronologically the important related events during the "Golden Age of England."
Arrange these events in the order that they occurred:
a) James I becomes King of England.
b) The death of Queen Elizabeth I.
c) The defeat of the Spanish Armada.
d) The death of Mary, Queen of Scots.
e) First English colony in America founded.

2) Objective: To name and order the four things to do to cross the street safely.
Name in order the four things you should do to cross the street safely.

The first example above is an instance in which the learner simply arranges in order a given list of referents. In Example 2 he must both name and order the referents.

5. Describe - The learner generates and names the necessary categories of objects, object properties, events, or event properties relevant to the description of a designated referent. The learner should respond in sufficient detail so that there is a probability of approximately one that any individual who can identify the referent by actually seeing it or reading the textbook description of it can also identify it by hearing or reading the learner's description.

Examples: 1) Objective = To describe a piñata.
Describe a piñata.

2) Objective = To describe the Battle of the Bulge.
Describe the Battle of the Bulge.

6. Construct - The learner generates a construction (i.e., a drawing, article of clothing or furniture, map, outline, etc.) which meets stated specifications. The teacher must decide in advance the amount of variation from stated specifications that will be acceptable.

Examples: 1) Objective = To construct isosceles triangles.
Draw an isosceles triangle.

2) Objective = To construct sentence outlines containing appropriate topics, subtopics and details.
Make a sentence outline of Chapter 3 that includes topics, subtopics, and details.

3) Objective = To construct coffee tables as instructed.
Build a 24" high coffee table with a 28" by 40" top, using these materials.

7. State a rule - The learner specifies in their proper order the object and event referents, the relationships, and the operations included in a principle or formula.

Examples: 1) Objective = To state the law of magnetism.
Write the law of magnetism.

2) Objective = To state the rule for computing the distance traveled by a freely falling object.
What is the rule for computing the distance traveled by a freely falling object?

8. Apply a rule - The learner makes a correct response (the actual performance may take the form of any of the first six terms in this list--from identifying through constructing) to a question or problem which can be correctly answered through the use of an acquired (i.e., previously stated by the learner) rule. This behavior requires an answer which can be arrived at by a direct use of the rule with no further interpretations or operations performed by the learner. For example, consider computing the distance traveled by a freely falling object ($d=\frac{1}{2}gt^2$). The learner who had acquired this rule could be required to identify or provide an answer giving the distance traveled by a falling object at a given time after release. However, he could not be required to, say, tell the speed of the object at a given time after release, because this behavior requires the learner to perform operations not directly stated in the rule.
The learner is not required to show or tell how he arrived at his answer, so actual use of the stated rule is not observable.

Examples: 1) Objective = To identify the distance traveled by a freely falling object x seconds after its release.
How far will a freely falling object travel in the first 3 seconds after its release?
a) 80 feet c) 144 feet
b) 96 feet d) 192 feet

2) Objective: To compute (name) the distance traveled by a freely falling object x seconds after its release.
How far will a freely falling object travel in the first two seconds after its release?

9. Demonstrate - The learner makes a correct response as specified above in "applying a rule," and he also performs the operations necessary to the application of the rule. That is, he not only shows the correct procedure specified by the rule but also indicates the correct answer, in contrast to "applying a rule," where he merely indicates or provides the correct answer.

Examples: 1) Objective = To compute (name) by correct use of the rule the distance traveled by a freely falling object x seconds after its release.
Compute the distance traveled by a freely falling object in the first four seconds after its release. Show your work.

2) Objective = To compute (name) by correct use of the rule the interest when the principal, rate, and time are given. (Relevant rule acquired: i=prt)
Show your work in computing the interest on a loan of $1500 at a rate of 6% per year for a two-year period.

In such subjects as math, algegra, physics and chemistry, the learner is frequently required to show his work by performing the operations specified in a rule (i.e., to demonstrate). However, in areas such as grammar, spelling and punctuation, the learner is normally expected to apply the rule (e.g., to use the correct pronoun or place the letters and punctuation marks in accordance with the rule without showing the procedure by which he selected them). That is, in these areas he normally is asked to apply the rule but not to demonstrate.

10. Interpret - The learner makes a response (any of the first six terms again apply) to indicate or provide a correct answer that is determinable from the relationships specified in a rule that the student has previously acquired.
However, unlike "applying a rule" behavior, the correct answer cannot be arrived at by a direct use of the rule, but requires learner performance of operations not explicitly stated in the rule.
Sutuations such as the following represent occasions in which interpreting behavior would be employed:
a) A new relationship between the component concepts of a rule must be established and employed to determine the correct answer.

Example: Objective = To compute (name) the rate when given the interest, principal and time. (Relevant rule acquired: i=prt)

1) What is the rate when interest = $40, principal= $1000, and time = 6 months?

b) Additional operations not explicitly stated in the rule must be employed to determine the correct answer.

Example: Objective = To compute (name) the speed of a freely falling object at given times after its release. (Relevant rule acquired : $d=\frac{1}{2}gt^2$)

1) At what speed will a freely falling object be traveling three seconds after its release?

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Sentence Completion Scale

Make a complete sentence of each of the following items by writing down your reaction to the item. Attempt to restrict your response set to the present institute, and your own personal needs and experiences in this regard. Do not write your name on this sheet.

Positive Neutral Negative
1. In general the Institute 23 1 0

Better planning-3; Too long-3; Too short-1; Not useful-1;
2. The Laboratory More individual atten.-3; Well organized-3; Useful-14

Positive Neutral Negative
3. Behavioral objectives 20 4 0

Excellent Good Fair Poor
4. The visiting lecturers 13 6 3 2

Time-6; Planning-3; Communication-3; References-2;
5. What the Institute needed most Feedback-5; Physical facilities-2; Better participants-1

Pos. Neutral Neg.
6. The course covering objectives and the IS 20 3 1

Positive Neutral Negative
7. The social program 18 4 2

Positive Neutral Negative
8. Analysis of variance 18 5 1

Too heavy Just right Too light
9. The work load 7 15 2

10. The thing I liked most --

Positive Neutral Negative
11. The lab assistants 23 1 0

Very helpful Adequate Inadequate
12. The advance information(mailings) 16 7 1

Excellent Good Fair Poor
13. The quality of instruction 12 10 2 0

Positive Neutral Negative
14. Educational research 19 4 1

15. The thing I liked least ---

Positive Neutral Negative
16. The course in proposal writing 16 7 1

Very helpful Adequate Inadequate
17. My research proposal 12 5 7

Positive Neutral Negative
18. The other participants 24 0 0

Positive Neutral Negative
19. The statistics and design course 18 4 2

Positive Neutral Negative
20. The Instructional Specification (IS) 18 4 2

21. I learned --

22. One last thing --

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Describing an Experiment in Education

(Exercise #2)

In any journal which reports original experimental research in education (e.g., the Journal of Educational Psychology), read a number of articles. When you have found one which illustrates most of the concepts which are covered in Part I of your lecture outline, write answers to the following questions:

1. What is the bibliographical citation for your article?
2. What kind of description is reported in the article?
3. What variables were observed?
4. What relationships between variables are reported? What kind of relationships are they?
5. Is there any attempt at explanation? If so describe and evaluate it. If not, defend or critize its absence.
6. Illustrate each of the six rules of the method of educational experimentation. If the article provides no material for any one or several of the rules, either defend the omission or show how the report could have been improved by an addition.
7. Can you read a research article more effectively now than you could a week ago? Elaborate, if you wish.
8. Did you have any specific research problem(s) on which you expected to work during the Institute? If so, outline them as clearly as possible.

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Key to Comments on Exercise 2

1. What study are you reporting?
2. You haven't listed all the variables.
3. The relationship doesn't depend on randomization.
4. You missed the author's attempt at explanation.
5. Were all the variables stated in behavioral terms?
6. Can the findings be generalized to areas outside the study? (Stanley's "external validity")
7. Were the relationships causal or not? Did a change in A produce a change in B?
8. Could he have observed more classes?
9. Exactly how were the findings and/or conclusions confirmed?
10. Is the explanation or conclusion consistent with findings outside the study?
11.
12. Unless a functional relationship was demonstrated, you don't have a process description.
13. Is the explanation warrented by the findings?
14. Are all the variables listed used in the study?

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Arizona State University

Rules of Thumb for Writing the ANOVA Table

Note: 13

Determining Mean Squares and Test of Significance

In developing the Rules of Thumb, much of their content is symbolic or conceptual and is not used in the actual computation of the ANOVA. As stated in the opening paragraph of Note 11, this is true of the Expectations of Mean Squares E(MS). It is a conceptulization which guides the computational use of the Mean Squares (MS) in the test of significance.

Computation of Mean Squares (MS)

Rule: The mean square for any source of variation is the sum of squares [(SS): see note 11] computed for that source of variation divided by the degrees of freedom [(df): see note 7] for that same source of variation.

Using our problem, the mean square for the PT interaction is found by taking the sum of squares $(SS)_{PT}$ and dividing it by the degrees of freedom [(p 1) (t-1)] for that interaction. Since in our exemplar problem there are no values provided for replications in each cell, the sums of squares can only be represented symbolically with (SS) and the subscript. We do have a value for the degrees of freedom so that a value can be expressed. For the PT interaction the mean square becomes $\frac{(SS)_{PT}}{4}$.

Test of Significance.

Since we are attempting to make a decision about a hypothesis form data collected, some process is needed to differentiate between the variations in the data due to error and those variations due to the treatment. In this connection the expectation mean square permits us to conceptualize that portion of the data not entirely a consequence of the treatment and slice it away leaving in the data only that which is a function of that we wish to analyze.

Rule: The correct expectation Mean Square E(MS) terms for a test of significance for any source of variation can be determined by dividing the E(MS) (see Note 11) for that source of variation (numerator) by the E(MS) for a source of variation (denominator) that contains all of the subscriped factors of the numerator except the subscripted factor denoting the principal sources of variation of interest.

Using our exemplar problem, the test of significance for the PT interaction is represented by developing a ratio where the E(MS) for PT ($\sigma e^2 + \sigma c^2 t{:}p + \sigma p^2 t$) is our numerator, and the denominator is the E(MS) for a source of variation containing all terms in the E(MS) for PT except the term $\sigma p^2 t$. An inspection of the E(MS) for our exemplar (see Note 11) indicates the E(MS) for the CT:P interaction ($\sigma e^2 + \sigma c^2 t{:}p$) is the appropriate denominator. The test of significance for the PT interaction is $\frac{E(MS)pt}{E(MS)_{ct:p}}$ or $\frac{\sigma e^2 + \sigma c^2 t{:}p + \sigma p^2 t}{\sigma e^2 + \sigma c^2 t{:}p}$. Likewise, the test of significance for C:P factor would be the E(MS) for C:P ($\sigma e^2 + \sigma c^{2}{:}p$) divided by the E(MS) for R:PCT (σe^2) thus represented as $\frac{E(MS)\ c{:}p}{E(MS)\ r{:}pct}$ or $\frac{\sigma e^2 + \sigma c^{2}{:}p}{\sigma e^2}$. Where it is not possible to find an E(MS) for the denominator, then a legitimate test of significance for that source of variation is not possible.

In transition to the computational level for the test of significance we now use the Mean Square (MS) discussed earlier in this note.

Rule: The test of significance computed for any source of variation is the ratio of the (MS) for that variation (numerator) and the (MS) of the variation (denominator) which corresponds to the denominator in the ratio for the test of significance using E(MS).

Refering again to our exemplar problem, the test of significance for the PT interaction is $\frac{(MS)_{pt}}{(MS)_{cp:t}}$ as these are the correspondent terms for the test of significance using E(MS) . Likewise, the test of significance for the C:P factor is $\frac{(MS)_{c:p}}{(MS)_{r:pct}}$ which are the analogous terms for the same ratio expressed as E(MS). Again, because our exemplar did not provide values in the cells, it is only possible to represent the test of significance symbolically for this example. The test of significance is a computational value from the Mean Squares.

The Analysis of Variance is based on the assumption that experimentation in education is a comparison of population variances. It, therefore, suggests that the appropriate test follows the distribution of random variable F (after Sir Ronald A. Fisher). The development of the test of significance, as stated in the forgoing rules, corresponds to the definition that "a random variable formed from the ratio of two independent...variables, each divided by its degrees of freedom, is said to be an F ratio and follow the rule of the F distribution."*

In using the F Table (commonly identified: Percentage Points of F Distribution, or Points for the Distribution of F), note that across the top are columns corresponding to the degrees of freedom for the numerator of the ratio and down the side of the table are rows corresponding to the degrees of freedom for the denominator of the ratio. The values in the table represent the ratios necessary for staticial significance at the designated levels of confidence (.05 and .01) for a particular combination of degrees of freedom.

Using our exemplar problem again, the ratio for the test of significance for the PT interaction is $\frac{(MS)_{PT}}{(MS)_{CT:P}}$ where the degrees of freedom for $(MS)_{PT}$ are 4 and the degrees of freedom for $(MS)_{CT:P}$ are 16. Referring to the table of F values, read across to column designated 4 (the degrees of freedom for the numerator) and down to the row designated 16 (the degrees of freedom for the denominator). The F value for 4 and 16 degrees of freedom is 3.01 at the .05 level of confidence and 4.77 at the .01 level. Therefore, the results of the computation $\frac{(MS)_{PT}}{(MS)_{CT:P}}$ must exceed 3.01 for significance at at the .05 level, and 4.77 for significance at the .01 level.

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*Hays, William L., Statistics for Psychologists. New York: Holt, Rinehart and Winston. p. 349.

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Note: 19

Experimental Design and Analysis of Data Review

As an administrator in a large school system part of your responsibilities relate to the systematic conduct of educational experiments. You have two assistants and one secretary available to assist you in your experimental efforts.

It is your intention to plan, conduct and disseminate the results of a fairly extensive research proposal. You have decided to study at least two factors related to learning. One of the factors should consist of at least four levels. Ten schools are available and you may select your sample in any way that you choose.

For the situation described above complete the following:

(1) Operationally state the substance of the experimental treatments you plan to administer. Exactly how do the treatments differ?

(2) What is your target population? How do you plan to draw your sample for the experiment?

(3) Using Campbell and Stanley as a guide, describe the design you will use in conducting your experiment. Give the rationale for your design selection.

(4) Which statistical device will you use in analyzing your data? Illustrate your plan for statistical analysis in data matrix form.

(5) Classify the factors you have chosen as either fixed or random. Give the rationale for your decision in each case.

(6) Using the Rules of Thumb for Writing the ANOVA Table complete the following for your analysis:*

- (a) Sources of Variation (possible lines)
- (b) Degrees of Freedom
- (c) Sums of Squares
- (d) Expected Mean Squares
- (e) Tests of Significance (Fratios)

* Solutions to question # 6 should be in symbolic form.

(7) Would you use a Newman-Keuls post ANOVA test? If so, why? If not, why not?

(8) What might you decide to do in conducting your experiment in order to make your statistical test more powerful?

(9) In reference to your statistical analysis what is the relationship between Type I and Type II errors?

Baker/Sattler 7/66

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1. Summary: Participant Critique Form August 6, 1966

Directions: Please respond with a word, a phrase, or one or more sentences to as many of the following questions as you can. Your frank and honest evaluation can only benefit everyone concerned. Do not identify yourself by name unless you prefer to do so.

1. To what extent did the relative unavailability of books and journals interfer with your attempts to master the content of this session?

   none: 12 some: 8 alot: 4

2. To what extent did reproduced materials given to you by the staff improve matters?

   none: 0 some: 2 alot: 22

3. Which features of the meeting rooms were inadequate or not conducive to learning?

   Tables and chairs

4. Which features were especially facilitative in the same regard?

   Air conditioning, lighting, two lab rooms, and caluclators

5. Was eight weeks too long a period to leave your work at home for the purpose of attending this session?

   yes: 10 no: 14

6. Was eight weeks too short a period in which to learn much of the content of this session?

   yes: 16 no: 9

7. Were you allowed enough time in which to pursue activities of your own choosing?

   yes: 13 no: 9

8. Would more than two organized meetings per day have been perferable?

   yes: 1 no: 23

9. Would you have preferred more meetings per day than there actually were?

   yes: 1 no: 23

10. Were the individual lectures too long to sit and listen or take notes?

yes: 8 no: 23

11. Were the lectures scheduled in an appropriate sequence?

yes: 21 no: 3

12. Did you have sufficient opportunities to interact with other participants?

yes: 18 no: 6

13. Were the instructors (Baker, Gerlach and Sullivan) too inaccessible or unapproachable so that you did not get the individual attention that you desired.

Baker: Reasonably approachable, Sullivan: Very approachable
Gerlach: Always available

14. In general, was the Institute well organized?

yes: 20 no: 4

15. Did the content of the lectures and readings presuppose far more previous training (in math and statistics) than you had?

yes: 15 no: 9

16. To what extent was the content of the lectures and readings relevant to what you hoped to accomplish during the session?

none: 1 mostly: 10 a great deal: 13

17. Were you disappointed in any way with the group of participants?

yes: 0 no: 24

18. If you had it to do over again, would you apply for this Institute which you have just completed.

yes: 22 no: 2

19. If an institute such as this is held again would you recommend to others like you that they attend?

yes: 22 no: 2

20. Do you anticipate maintaining some sort of contact with at least one member of the institute staff.

yes: 23 no: 1

21. Do you feel that your understanding of research design and/or statistical analysis has been considerably enriched in these eight weeks?

    yes: 23 no: 1

22. Do you feel that USOE is making an important contribution to education by sponsoring institutes such as this one?

    yes: 23 no: 1

23. Do you feel that anything has happened during these eight weeks to make it more likely that you will leave your present position of employment?

    yes: 5 no: 19

24. Would you say that because of this Insitute you are more able to state a given educational problem in operational form so that it is, if it can be, amenable to experimentation?

    yes: 23 no: 1

25. Do you feel that the staff should feel that it has accomplished its objectives during this eight week Institute?

    yes: 23 no: 1

APPENDIX J

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2. Summary: Institute Concept Rating Sheet

Do not write your name on this booklet.

The purpose of this instrument is to measure the meanings of certain concepts related to the institute. On each page of this booklet you will find two different concepts to be judged, and a set of scales beneath each concept. You are to rate each concept on each scale in order.

Here is how you are to use the scales:

If you feel that the concept at the top of the page is very closely related to one end of the scale, you should place your check-mark as follows:

Fair __X__: ______: ______: ______: ______: Unfair
or
Fair ______: ______: ______: ______: __X__: Unfair

If you feel that the concept is moderately related (but not highly related) to one or the other end of the scale, you should place you check-mark as follows:

Strong ______: __X__: ______: ______: ______: Weak
or
Strong ______: ______: ______: __X__: ______: Weak

If you consider the concept to be neutral on the scale, place your check-mark in the middle space:

Safe ______: ______: __X__: ______: ______: Dangerous

IMPORTANT: (1) Place your check-marks in the middle of spaces not on the boundaries:

[This] [Not This]
______: __X__: ______: X______: ______:

(2) Be sure you check every scale for every concept.

(3) Never put more than one check-mark on a single scale.

Work at a fairly high speed through this rating sheet. Do not puzzle over individual items. Give your first impressions, your immediate feelings about each item. Please do not be careless, however.

Stake

1. good	5	10	7	2	0	bad
2. unfriendly	0	1	4	10	9	friendly
3. stimulating	2	7	8	7	0	dull
4. positive	2	12	5	5	0	negative
5. unhelpful	0	3	8	10	3	helpful
6. right	3	12	8	10	3	wrong
7. incapable	0	3	0	14	7	capable
8. unavailable	1	1	5	11	6	available
9. interesting	3	10	8	2	1	uninteresting
10. unsuccessful	0	1	0	13	1	successful
11. prepared	9	6	4	5	0	unprepared
12. acceptant	9	6	4	5	0	rejecting

Dershimer

1. good	1	7	9	6	1	bad
2. unfriendly	0	1	10	10	3	friendly
3. stimulating	2	6	7	6	3	dull
4. positive	3	12	8	1	0	negative
5. unhelpful	0	4	7	11	2	helpful
6. right	0	9	12	3	0	wrong
7. incapable	1	2	6	13	2	capable
8. unavailable	0	0	10	11	3	available
9. interesting	1	7	9	3	4	uninteresting
10. uneuccessful	0	2	12	8	2	successful
11. prepared	1	12	7	3	1	unprepared
12. acceptant	1	8	12	3	0	rejecting

Rabinowitz

1.	good	12	8	2	2	0	bad
2.	unfriendly	1	1	2	10	10	friendly
3.	stimulating	13	7	1	3	0	dull
4.	positive	7	14	1	2	0	negative
5.	unhelpful	1	2	4	9	8	helpful
6.	right	4	11	6	2	1	wrong
7.	incapable	2	0	1	7	14	capable
8.	unavailable	0	0	3	12	9	available
9.	interesting	13	8	0	2	1	uninteresting
10.	unsuccessful	1	0	3	9	11	successful
11.	prepared	14	6	0	3	1	unprepared
12.	acceptant	8	8	5	3	0	rejecting

Silberman

1.	good	6	13	2	2	0	bad
2.	unfriendly	0	0	4	15	4	friendly
3.	stimulating	7	8	3	5	0	dull
4.	positive	5	16	1	2	0	negative
5.	unhelpful	0	3	5	12	3	helpful
6.	right	1	11	11	0	0	wrong
7.	incapable	0	0	1	10	12	capable
8.	unavailable	0	0	4	16	3	available
9.	interesting	7	13	0	2	1	uninteresting
10.	uneuccessful	0	1	3	13	6	successful
11.	prepared	8	11	2	2	0	unprepared
12.	acceptant	4	11	8	0	0	rejecting

Stanley

1.	good	16	7	1	0	0	bad
2.	unfriendly	0	0	0	5	19	friendly
3.	stimulating	16	7	1	0	0	dull
4.	positive	13	10	1	0	0	negative
5.	unhelpful	0	1	0	8	15	helpful
6.	right	8	11	4	1	0	wrong
7.	incapable	0	0	0	2	22	capable
8.	unavailable	0	0	0	7	17	available
9.	interesting	16	8	0	0	0	uninteresting
10.	unsuccessful	0	0	0	10	14	successful
11.	prepared	18	6	0	0	0	unprepared
12.	acceptant	14	7	3	0	0	rejecting

Popham

1.	good	7	9	5	3	0	bad
2.	unfriendly	3	3	4	6	8	friendly
3.	stimulating	7	11	5	1	0	dull
4.	positive	8	9	2	3	2	negative
5.	unhelpful	0	2	4	9	9	helpful
6.	right	3	9	9	2	1	wrong
7.	incapable	0	1	1	14	8	capable
8.	unavailable	1	0	5	11	7	available
9.	interesting	7	12	2	3	0	uninteresting
10.	unsuccessful	1	1	7	11	4	successful
11.	prepared	11	8	3	2	0	unprepared
12.	acceptant	11	8	3	2	0	rejecting

Sattler

1. good	9	12	3	0	0	bad
2. unfriendly	0	0	0	8	16	friendly
3. stimulating	4	12	8	0	0	dull
4. positive	0	12	3	0	0	negative
5. unhelpful	0	0	0	9	15	helpful
6. right	5	11	8	0	0	wrong
7. incapable	0	0	1	13	10	capable
8. unavailable	0	0	1	6	17	available
9. interesting	8	12	4	0	0	uninteresting
10. unsuccessful	0	0	2	12	10	successful
11. prepared	13	9	2	0	0	unprepared
12. acceptant	12	8	4	0	0	rejecting

Slattery

1. good	7	12	5	0	0	bad
2. unfriendly	0	0	0	6	18	friendly
3. stimulating	4	11	8	0	1	dull
4. positive	5	14	3	2	0	negative
5. unhelpful	0	0	1	12	11	helpful
6. right	5	7	12	0	0	wrong
7. incapable	0	0	5	12	7	capable
8. unavailable	0	0	0	11	13	available
9. interesting	7	9	7	1	0	uninteresting
10. unsuccessful	0	1	5	13	5	successful
11. prepared	7	9	6	1	1	unprepared
12. acceptant	10	9	3	2	0	rejecting

Sullivan

1.	good	9	11	4	0	0	bad
2.	unfriendly	0	0	0	1	23	friendly
3.	stimulating	4	10	8	1	1	dull
4.	positive	9	14	1	0	0	negative
5.	unhelpful	0	0	0	8	16	helpful
6.	right	7	7	10	0	0	wrong
7.	incapable	0	0	1	14	9	capable
8.	unavailable	0	0	3	9	12	available
9.	interesting	6	11	3	3	1	uninteresting
10.	unsuccessful	1	2	0	12	9	successful
11.	prepared	12	6	4	2	0	unprepared
12.	acceptant	16	5	3	0	0	rejecting

Baker

1.	good	18	4	2	0	0	bad
2.	unfriendly	0	2	3	12	7	friendly
3.	stimulating	17	6	1	0	0	dull
4.	positive	16	7	0	1	0	negative
5.	unhelpful	0	2	1	12	9	helpful
6.	right	9	11	4	0	0	wrong
7.	incapable	0	0	0	5	19	capable
8.	unavailable	1	2	11	5	5	available
9.	interesting	18	3	2	1	0	uninteresting
10.	uneuccessful	0	0	1	7	16	successful
11.	prepared	18	5	1	0	0	unprepared
12.	acceptant	9	9	5	0	1	rejecting

Participants

1. good	14	9	1	0	0	bad
2. unfriendly	0	0	0	4	20	friendly
3. stimulating	11	12	0	1	0	dull
4. positive	6	14	3	1	0	negative
5. unhelpful	0	0	0	8	16	helpful
6. right	3	8	13	0	0	wrong
7. incapable	0	0	0	18	6	capable
8. unavailable	0	0	4	5	15	available
9. interesting	17	7	0	0	0	uninteresting
10. unsuccessful	0	0	2	18	4	successful
11. prepared	5	13	5	1	0	unprepared
12. acceptant	13	9	2	0	0	rejecting

Gerlach

1. good	13	8	3	0	0	bad
2. unfriendly	0	0	1	8	15	friendly
3. stimulating	6	13	4	0	0	dull
4. positive	12	10	2	0	0	negative
5. unhelpful	0	0	0	8	16	helpful
6. right	5	14	5	0	0	wrong
7. incapable	0	0	0	14	10	capable
8. unavailable	0	0	0	3	21	available
9. interesting	9	13	0	2	0	uninteresting
10. unsuccessful	0	1	1	15	7	successful
11. prepared	12	9	0	3	0	unprepared
12. acceptant	12	10	2	0	0	rejecting

Institute

1.	good	15	8	1	0	0	bad
2.	useless	0	1	1	8	14	valuable
3.	stimulating	14	9	1	0	0	dull
4.	positive	10	13	1	0	0	negative
5.	unorganized	0	0	5	9	10	organized
6.	impractical	0	0	1	14	9	practical
7.	passive	0	1	1	10	12	active
8.	important	11	12	1	0	0	unimportant
9.	satisfying	8	14	2	0	0	disappointing
10.	unsuccessful	0	0	2	14	8	successful

Lectures

1.	good	9	9	6	0	0	bad
2.	useless	0	1	1	15	7	valuable
3.	stimulating	7	10	6	1	0	dull
4.	positive	8	14	2	0	0	negative
5.	unorganized	0	0	5	10	9	organized
6.	impractical	0	0	0	17	7	practical
7.	passive	1	0	5	12	6	active
8.	important	9	12	2	1	0	unimportant
9.	satisfying	9	8	5	2	0	disappointing
10.	unsuccessful	0	1	5	12	6	successful

Educational Research

1. good 7 : 13 : 4 : 0 : 0 bad
2. useless 0 : 1 : 1 : 12 : 10 valuable
3. stimulating 7 : 12 : 4 : 1 : 0 dull
4. positive 7 : 12 : 5 : 0 : 0 negative
5. unorganized 0 : 1 : 7 : 10 : 6 organized
6. impractical 0 : 0 : 3 : 12 : 9 practical
7. passive 0 : 0 : 3 : 14 : 7 active
8. important 13 : 9 : 2 : 0 : 0 unimportant
9. satisfying 3 : 16 : 5 : 0 : 0 disappointing
10. unsuccessful 0 : 1 : 6 : 14 : 3 successful

Laboratory

1. good 8 : 10 : 5 : 0 : 1 bad
2. useless 0 : 2 : 1 : 13 : 8 valuable
3. stimulating 4 : 7 : 10 : 2 : 1 dull
4. positive 5 : 13 : 5 : 1 : 0 negative
5. unorganized 0 : 2 : 5 : 11 : 6 organized
6. impractical 0 : 1 : 2 : 11 : 10 practical
7. passive 0 : 1 : 3 : 11 : 9 active
8. important 8 : 11 : 4 : 1 : 0 unimportant
9. satisfying 4 : 9 : 8 : 2 : 1 disappointing
10. unsuccessful 0 : 2 : 9 : 11 : 5 successful

Exercises and Assignments

1. good 7 : 12 : 2 : 2 : 0 bad
2. useless 0 : 1 : 2 : 12 : 8 valuable
3. stimulating 8 : 10 : 5 : 0 : 0 dull
4. positive 8 : 12 : 3 : 0 : 0 negative
5. unorganized 0 : 1 : 2 : 11 : 9 organized
6. impractical 0 : 0 : 3 : 14 : 6 practical
7. passive 0 : 0 : 5 : 7 : 11 active
8. important 9 : 12 : 1 : 1 : 0 unimportant
9. satisfying 2 : 14 : 4 : 3 : 0 disappointing
10. unsuccessful 0 : 1 : 4 : 13 : 5 successful

My Achievement

1. good 3 : 16 : 4 : 1 : 0 bad
2. useless 0 : 0 : 1 : 10 : 13 valuable
3. stimulating 9 : 11 : 4 : 0 : 0 dull
4. positive 10 : 13 : 1 : 0 : 0 negative
5. unorganized 0 : 0 : 6 : 12 : 6 organized
6. impractical 0 : 0 : 1 : 14 : 9 practical
7. passive 0 : 0 : 4 : 9 : 11 active
8. important 10 : 10 : 3 : 1 : 0 unimportant
9. satisfying 8 : 13 : 3 : 0 : 0 disappointing
10. unsuccessful 0 : 1 : 2 : 14 : 7 successful